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May 31, 2018

VIA ELECTRONIC FILING

**The Honorable Jocelyn G. Boyd
Chief Clerk/Administrator
Public Service Commission of South Carolina
101 Executive Center Drive
Columbia, South Carolina 29210**

**RE: South Carolina Electric & Gas Company
Application of South Carolina Electric & Gas Company for Approval to
Continue Demand Side Management Programs and Included Rate
Rider, and for Approval of Revised Portfolio of Energy Efficiency
Programs; Docket No. 2013-208-E**

Dear Ms. Boyd:

In accordance with Order No. 2013-826 in the above-referenced docket, South Carolina Electric & Gas Company hereby files with the Public Service Commission of South Carolina a copy of the Company's Evaluation, Measurement and Verification report ("EM&V Report") for Program Year 7, which consists of the time period December 1, 2016, to November 30, 2017.

By copy of this letter, we are also providing a copy of the EM&V Report to the South Carolina Office of Regulatory Staff and enclose a certificate of service to that effect. We are also providing counsel for the other parties in the above-referenced docket with a courtesy copy of the report.

If you have any questions, please advise.

Very truly yours,

Matthew W. Gissendanner

MWG/kms
Enclosure

The Honorable Jocelyn G. Boyd, Esquire
May 31, 2018
Page 2

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(all via electronic mail and U.S. First-Class Mail w/enclosure)

BEFORE
THE PUBLIC SERVICE COMMISSION OF
SOUTH CAROLINA
DOCKET NO. 2013-208-E

IN RE:

Application of South Carolina Electric & Gas company for Approval to Continue Demand Side Management Programs and Included Rate Rider, and for Approval of Revised Portfolio of Energy Efficiency Programs)))))))	CERTIFICATE OF SERVICE
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This is to certify that I have caused to be served this day one (1) copy of South Carolina Electric & Gas Company's Evaluation, Measurement and Verification ("EM&V") Report to the persons named below at the addresses set forth:

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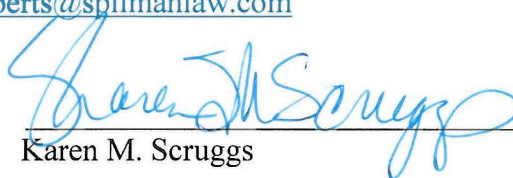
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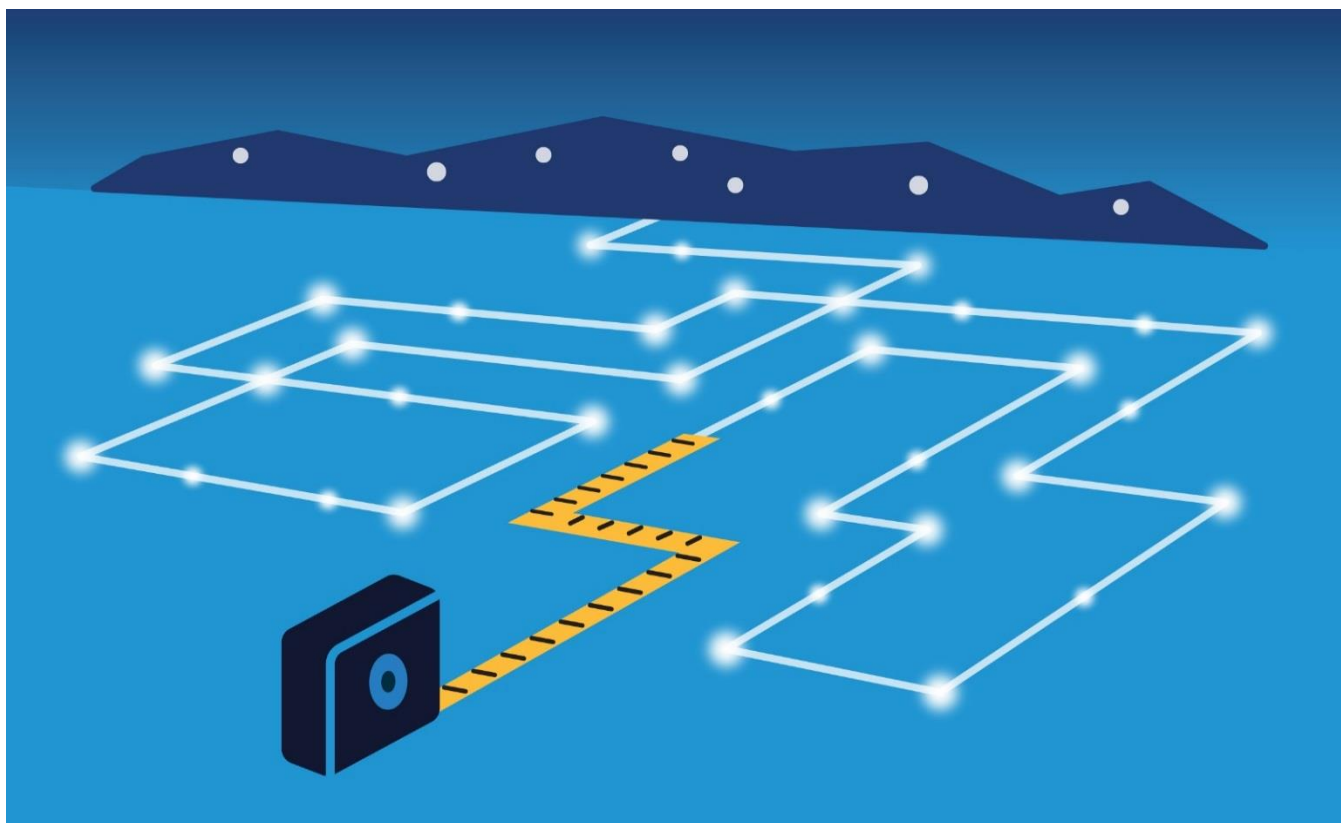
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This 31st day of May, 2018



South Carolina Electric & Gas Company EnergyWise Program Year 7: Evaluation, Measurement and Verification Report

Megan Campbell
Vice President
May 2018

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1. Executive Summary

South Carolina Electric & Gas Company (SCE&G) began offering customer energy efficiency programs in October 2010. The period from December 1, 2016, through November 30, 2017, constituted their seventh program year (PY7). Over this period, SCE&G administered six programs for residential electric customers and two programs for commercial and industrial (C&I) electric customers. The purpose of this report is to provide ex-post PY7 gross and net program energy and demand savings estimates as compared to the company's forecasted and SCE&G reported (ex-ante) savings.

SCE&G forecasted gross savings of 67,324 MWH and 16.28 MW for the PY7 portfolio of energy efficiency programs. The evaluation found ex-post gross savings met 106% of the energy savings forecast and 89% of the demand forecast. In PY7, SCE&G spent approximately \$12.7M dollars implementing these programs¹, just 1% less than the spending forecast. Table 1 presents gross savings, costs and participation for each program, comparing each to PY7 forecasts.

In PY7, SCE&G continued to help customers adopt more energy efficient lighting through an ENERGY STAR® Online Lighting Store, giveaways to customers visiting SCE&G business office locations, and mailed LED bulbs to targeted customers in hard-to-reach areas. SCE&G continued to help income-qualified customers save energy and reduce energy bills by installing energy efficient lighting and other products through its Neighborhood Energy Efficiency (NEEP) Program. In addition, SCE&G continued to offer weatherization measures for income-qualified mobile home customers as part of an effort first implemented in PY6. SCE&G also continued to increase the promotion and installation of LED bulbs while phasing out CFL bulbs. The Heating & Cooling, Appliance Recycling (ARP), Home Energy Check-up (HEC) and Home Energy Reports (HER) programs continued to serve residential customers in PY7 and the Small Business Energy Solutions (SBES) and EnergyWise for Your Business (EWfYB) Programs continued to help commercial customers seize energy efficient opportunities.

This report contains a chapter for each program and presents the ex-post gross and net savings and a discussion of the program's performance compared to forecasts and ex-ante estimates.

¹ Program costs reported here do not account for amortization or interest.

Executive Summary

Table 1. Portfolio Ex-Post Gross Savings, Costs and Participation

Program Name	Ex-Post Gross Savings				Program Costs		Participation		
	MWH Actual	% of Forecast	MW Actual	% of Forecast	Actual	% of Forecast	Actual	% of Forecast	Definition
ENERGY STAR® Lighting	6,680	87%	0.61	80%	\$1,036,056	79%	216,439	161%	Bulbs
Home Energy Reports	6,296	43%	2.26	39%	\$547,389	75%	41,324	101%	Customers/ Households
Heating & Cooling	3,930	263%	2.75	261%	\$1,474,174	103%	4,521	90%	Measures
Neighborhood Energy Efficiency Program	3,637	181%	0.38	115%	\$1,129,404	131%	3,104	155%	Customers
Appliance Recycling	3,218	141%	0.37	129%	\$708,869	119%	3,114	104%	Customers
Home Energy Check-up	2,311	106%	0.37	84%	\$692,026	86%	2,880	88%	Customers
EnergyWise for Your Business	38,287	121%	5.88	101%	\$4,755,438	106%	756	116%	Projects
Small Business Energy Solutions	6,766	129%	1.89	107%	\$2,398,219	93%	598	94%	Projects
Total	71,125	106%	14.50	89%	\$12,741,575	99%	272,736	143%	

Notes: This report compares ex-post gross savings to PY7 forecasts stated in South Carolina Electric & Gas Company's Annual Update on Demand Side Management Programs and Petition to Update Rate Rider submitted in January 2017 to the Public Service Commission of South Carolina <https://dms.psc.sc.gov/Web/Dockets/Detail/116193>; program costs presented in the report do not account for amortization or interest (carrying costs).

Executive Summary

The overall portfolio achieved net savings (savings attributable to SCE&G's program offerings) of 55,046 MWH and 11.23 MW, which amounts to 77% of the gross energy and demand savings. The net-to-gross-ratios (NTGRs) indicate that SCE&G's incentives and services are influencing the majority of customers to save energy.

Table 2. PY7 Ex-Post Gross and Net Savings

Program Name	Energy Savings			Demand Savings		
	Gross MWH Savings	NTGR	Net MWH Savings	Gross MW Savings	NTGR	Net MW Savings
EnergyWise for Your Business	38,287	0.72	27,567	5.88	0.75	4.41
Small Business Energy Solutions	6,793	0.96	6,495	1.88	0.98	1.84
ENERGY STAR® Lighting	6,680	0.75	5,007	0.61	0.75	0.46
Home Energy Reports	6,296	1.00	6,296	2.26	1.00	2.26
Heating & Cooling	3,930	0.56	2,212	2.75	0.49	1.36
Neighborhood Energy Efficiency Program	3,637	1.00	3,637	0.38	1.00	0.38
Appliance Recycling	3,218	0.62	2,011	0.37	0.65	0.24
Home Energy Check-up	2,311	0.79	1,821	0.37	0.74	0.28
Total	71,152		55,046	14.50		11.23

As shown in Table 3, most of the PY7 energy savings came from the EWfYB program. Higher than forecasted savings per project for the SBES program and just over 41,000 customers participating in the Home Energy Report Program also contributed a significant amount.

Table 3. Program Contribution to Overall Portfolio Gross and Net MWH Savings

Program	Contribution to Gross MWH	Contribution to Net MWH
EnergyWise for Business	54%	50%
Small Business Energy Solutions	10%	12%
Home Energy Reports	9%	11%
ENERGY STAR® Lighting	9%	9%
Heating & Cooling	6%	4%
Neighborhood Energy Efficiency Program	5%	7%
Appliance Recycling	5%	4%
Home Energy Check-up	3%	3%

Executive Summary

Table 4 compares the ex-post gross savings (total estimated savings, exclusive of free-ridership and spillover) to the savings reported in SCE&G's Annual Update on Demand Side Management Programs and Petition to Update Rate Rider submitted in January 2018 to the Public Service Commission of South Carolina (ex-ante). The PY7 impact evaluation found ex-post savings equal to 95% of the ex-ante energy savings and 82% of the ex-ante demand savings. The ENERGY STAR® Lighting and NEEP Programs show the largest difference between ex-post and ex-ante and that was primarily due to changes in baseline assumptions for the lighting offered in each program.

Table 4. PY7 Ex-Post Gross Realization Rates

Program Name	MWH			MW			Reasons for Difference
	Ex-Ante	Ex-Post	RR	Ex-Ante	Ex-Post	RR	
Home Energy Reports	6,509	6,296	97%	2.48	2.26	91%	Ex-post prorated adjustments made to PY7 final bill and opt out participants correcting a small rounding error decreased energy and demand savings.
Home Energy Check-up	2,612	2,311	88%	0.49	0.37	76%	Baseline assumptions for lighting updated to reflect halogen baseline for EISA-impacted bulbs.
ENERGY STAR® Lighting	9,920	6,680	67%	0.90	0.61	68%	Baseline assumptions updated to reflect halogen baseline for EISA-impacted bulbs, applied installation rates, corrected database errors, and updated savings to include all three program components.
Heating & Cooling	3,917	3,930	100.3%	3.75	2.75	73%	Corrected small ex-ante reporting error.
Neighborhood Energy Efficiency Program	3,112	3,637	117%	0.31	0.38	123%	Changed to existing conditions baseline for lighting; corrected small data tracking error; included mobile home savings.
Appliance Recycling	3,569	3,218	90%	0.40	0.37	92%	New UMP protocol for evaluating recycled freezer savings and adjusted savings based on the size and age of PY7 recycled appliances.
EnergyWise for Your Business	38,474	38,287	100%	7.46	5.88	79%	Differences between ex-ante savings methods and the recommended methods in the SCE&G Commercial Energy Algorithm Manual (CEAM) for prescriptive lighting and HVAC measures; corrected data tracking errors related to building type and measure location.
Small Business Energy Solutions	6,805	6,766	99.4%	1.89	1.88	99.3%	Corrected minor program tracking database error.
Total	74,918	71,125	95%	17.69	14.50	82%	

2. Evaluation Methods

The purpose of this PY7 report is to verify the actual gross and net program energy and demand savings estimates and compare them to the company's forecast and ex-ante estimates. The Evaluation Team conducted a variety of data collection and analytical methods to verify gross and net savings for each program. Given that many of the programs and measures were evaluated in PY6 and that most programs did not change their design or measure-mix offered, PY7 evaluation efforts relied upon much of the PY6 evaluation efforts for installation rates and NTG ratios. A high-level description of the evaluation methods are provided below.

- **Database Review Verification:** The Evaluation Team reviewed program-tracking databases to ensure that there were no duplicates or database errors and that SCE&G had accurately applied all agreed-upon PY7 deemed savings for each measure.
- **Engineering Desk Review & Analysis:** The Evaluation Team conducted a full engineering desk review of measures in PY1-PY6 evaluations. As a result, the Evaluation Team recommended the application of new deemed savings estimates for some measures prospectively in future program years. The team conducted this activity again in PY7 for select programs and measures. For example, the Appliance Recycling Program measure savings were evaluated based on the measure characteristics that were recycling in PY7. The Evaluation Team also followed a new impact evaluation protocol for calculating recycled freezer savings based on the most recent update to the Uniform Methods Project (UMP). Heating and cooling measure savings were also evaluated based on the baseline conditions, measure and household characteristics in PY7. Further, the baseline assumptions for lighting measures were analyzed for all lighting measures offered through all residential programs to account for EISA legislation, where applicable.
- **Project Desk Review:** The Evaluation Team conducted engineering desk reviews of a representative sample of the EWfYB participants. The Evaluation Team reviewed several sources of information to inform savings calculations, including post installation electric usage, and then applied the realization rate to the population of projects.
- **Application of Previous Evaluated Inputs:** The Evaluation Team and SCE&G determined where to focus evaluation funds in PY7 based on implementation costs, specific needs for each program and how the program was evaluated in previous years. As such, some of the previous evaluation findings were applied to PY7 savings. For example, persistence rates for measures in the NEEP and SBES programs were developed in previous evaluations and were applied to the measure counts in PY7.
- **New Installation Rates and NTGR Research:** The Evaluation Team conducted a survey with a representative sample of customers who received LED mail kits, a new component in the Residential Lighting Program. The survey captured self-reported installation rates, free-ridership and spillover. These data provided inputs to the impact evaluation for PY7.

Evaluation Methods

Table 5 shows the data collection and analytical methods the Evaluation Team applied for each program. This report contains a chapter for each program that provides more detailed data collection and analytical methods and even further details can be found in the Appendices. More rigorous evaluation methods were focused on new program components and measures in PY7 and on the EnergyWise for Your Business Program as that program accounts for most of the portfolio savings.

Table 5. Portfolio Evaluation Methods

Evaluation Method	ENERGY STAR® Lighting	Heating & Cooling	Neighborhood Energy Efficiency	Appliance Recycling	Home Energy Check-Up	Home Energy Reports	EnergyWise for Your Business	Small Business Energy Solutions
Reviewed Data-Tracking Systems against Deemed Savings and Corrected Tracking Errors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Application of Previous Evaluated Findings (NTGR, Verification, Leakage, Savings per Participant and/or realization rates)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Engineering Desk Review & Analysis	Yes	Yes	Yes	Yes	Yes		Yes	
Project Desk Reviews							Yes	
Surveys for new ISR/NTGR	Yes; for new LED Mail Kit Component							

3. Program-Specific Findings

3.1 ENERGY STAR® Lighting Program

3.1.1 Program Description

In PY4, SCE&G discontinued its ENERGY STAR® Residential Lighting Program in favor of the EnergyWise Savings Store (Online Store) and a supplemental lighting offering referred to as the Business Office Lighting (BOL) Program. The key reason for the shift in program design was a desire to eliminate product leakage to non-SCE&G customers. Similar to the upstream Residential Lighting Program, the goal of the new lighting offerings was to advance residential customer knowledge and adoption of energy efficient lighting products. PY7 was the third year of implementing the Online Store and the BOL programs and marked the introduction of a new Low-Income Light Emitting Diode (LED) mailed kit component.

Online Store

As part of the Online Store, SCE&G offered its residential customers a range of standard and specialty LED products at discounted prices. Only customers with SCE&G electric service could purchase lighting products through the Online Store, thus minimizing leakage to non-SCE&G customers. Customers had the option to purchase products offered online or over the phone and were limited to purchases of 15 bulbs per eligible customer account per year based on previous EM&V recommendations. Energy Federation Inc. (EFI) continued to implement the program in PY7. Program marketing included direct mail, bill inserts, online banner ads, news releases, cross-marketing through other DSM programs and promotions on the SCE&G website homepage and social media websites.

Business Office Lighting (BOL) Program

In an effort to reach underserved customer segments, SCE&G offered free LED kits to customers who visited select SCE&G business offices across the SCE&G service area. The BOL LED kits consisted of five standard LEDs, including three 60-Watt equivalent bulbs, one 75-Watt equivalent bulb, and one 100-Watt equivalent bulb. Any SCE&G residential electric customers visiting the participating business offices during the promotional periods were eligible to receive one free kit per eligible residential account.

Low-Income LED Mailed Kits

In PY7, SCE&G initiated a new offering in an effort to reach underserved low-income customer segments. Postcards were sent to targeted customers living in neighborhoods with a high proportion of low-income qualified customers based on U.S. Census data. The offer was intended to supplement the Neighborhood Energy Efficiency Program, which was having a hard time reaching these neighborhoods in a cost-effective manner. Recipients were invited to claim one free LED kit by requesting it online or via telephone using a promo code. Each kit contained five standard 60-Watt-equivalent LEDs.

3.1.2 Program Performance Summary

Table 6 shows the program performance summary. SCE&G exceeded its forecast for the number of units, or bulbs, incentivized and at a lower cost than forecasted. While actual cost was below forecasted levels, program participation was well above forecasted bulb counts. While SCE&G does not provide separate forecasts for each component of its lighting program, SCE&G staff reported that the Online Store in particular far exceeded sales expectations. However, even after incorporating carryover savings from installation of previous program years' bulb sales that were not considered in the PY7 forecast, the program achieved 87% of its gross energy savings forecast and 80% of its gross demand savings forecast. The lower than forecasted savings are primarily due to the application of an in-service rate (ISR) for bulbs sold or given in PY7, and baseline savings adjustments due to the Energy Independence and Security Act (EISA). In previous years, the Evaluation Team used slightly higher baseline wattages for these products to allow for sell-through of incandescent products that the regulations were phasing out.

Table 6. ENERGY STAR® Lighting Program Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Cost	\$1,309,350	\$1,036,056	79%
PY7 bulbs	134,840	216,439	161%
Gross MWH Savings	7,680	6,680	87%
Gross MW Savings	0.76	0.61	80%
Net MWH Savings	N/A	5,007	N/A
Net MW Savings	N/A	0.46	N/A

3.1.3 Impact and Data-Tracking Findings

The Evaluation Team reviewed and verified program tracking data for accuracy and completed an engineering review to determine revised gross savings for each of the three lighting program components. The Evaluation Team then applied the in-service rate (ISR) to revised savings estimates to determine ex-post gross savings. We then applied component-specific net-to-gross rates to ex-post gross savings to estimate ex-post net savings.

More specifically, the impact analysis included the following steps for each program component:

- Review of measure counts and program-tracking data for accuracy
- Engineering analysis of deemed measure savings
- Application of ISR
- Application of NTGR

Table 7 provides a breakdown of energy and demand savings impacts in PY7. The Online Store was the core contributor to overall savings, accounting for 81% of revised gross savings. Within the Online Store program, LEDs accounted for virtually all ex-ante savings as CFLs were entirely phased out in early 2017. Across the three components, the overall gross energy savings realization rate (RR) is 56% before accounting for carryover savings. The application of installation rates accounts for most of the difference between ex-ante and ex-post savings, but revised wattage and baseline wattage assumptions due to EISA legislation and some small

Program-Specific Findings

database calculation errors also contributed to the difference. With the addition of carryover savings from bulbs sold in previous years that were installed in PY7, the gross energy savings realization rate is 67%.

Further, net savings account for 75% of the gross savings overall for the program. We applied component-specific NTG ratios to calculate net savings, which is further described in the component specific sections below.

Table 7. Ex-Post Gross and Net Savings Summary

Program	Verified Bulb Quantity	Ex-Ante Gross Savings		Revised Gross Savings		Ex-Post Gross Savings		Gross Savings RR*		Ex-Post Net Savings	
		MWH	MW	MWH	MW	MWH	MW	MWH	MW	MWH	MW
Online Store	177,854	8,173	0.74	7,027	0.64	4,498	0.41	55%	55%	3,283	0.30
BOL	34,305	1,553	0.14	1,488	0.14	997	0.09	64%	64%	827	0.08
Low-Income LED Kits	4,280	194	0.02	159	0.01	97	0.01	50%	52%	92	0.01
PY7 First-Year Savings	216,439	9,920	0.90	8,674	0.79	5,591	0.51	56%	57%	4,203	0.38
Carryover Savings from PY5 Measures						207	0.02	N/A	N/A	154	0.01
Carryover Savings from PY6 Measures						882	0.08	N/A	N/A	650	0.06
Total PY7 Savings						6,680	0.61	67%	68%	5,007	0.46

*Reflects the quotient of ex-post gross and ex-ante gross savings.

Online Store Impacts

The Evaluation Team checked the tracking data for errors such as duplicates and missing values, and updated per-unit savings for measures with outdated baseline wattage assumptions.

The revised gross savings reflect the accurate quantities from the program tracking data and updated per-unit savings for certain measures. To estimate revised gross savings, we used a halogen equivalent for baseline wattages for bulbs impacted by EISA legislation. The Evaluation Team made this adjustment to baseline wattages due to changes in less efficient product availability. In PY5 and PY6, we explored the availability of incandescent bulbs on store shelves across SCE&G's territory. In PY6, evaluation results suggested that some stores still had incandescent bulbs on the shelves, therefore we used a mixed halogen and incandescent baseline to estimate PY6 gross savings. However, in PY7, market intelligence suggested that very few incandescent bulbs can still be purchased in stores, and therefore we used a full halogen baseline for EISA-impacted bulbs to estimate revised gross savings. To estimate ex-post savings, we applied an in-service rate (ISR) of 64%, which we estimated as part of the PY6 evaluation of the Online Store program.

Table 8 shows the resulting ex-post gross savings. The Online Store Program saved 4,498 MWH and 0.41 MW, resulting in a gross savings realization rate of 55% for both energy and demand savings.

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Table 8. Online Store Gross Savings Summary

Component	MWH	MW
Ex-Ante Gross Savings	8,173	0.74
Revised Gross Savings	7,027	0.64
In-Service Rate	64%	
Ex-Post Gross Savings	4,498	0.41
Gross Savings Realization Rate	55%	55%

Note that the values are rounded and therefore might not sum or divide to the totals or realization rates listed in this table.

The Evaluation Team applied a NTGR of 0.73, based on PY6 evaluation results. Table 9 displays PY7 ex-post gross and net savings for the Online Store. As can be seen in the table, the Online Store achieved 3,283 MWH and 0.30 MW in net savings in PY7.

Table 9. Online Store Ex-Post Savings Summary

Component	MWH	MW
Ex-Post Gross Savings	4,498	0.41
NTGR	0.73	
Ex-Post Net Savings	3,283	0.30

Business Office Lighting Program Impacts

Review of the BOL program component tracking data revealed that measure counts were accurate and complete. As part of the review, the Evaluation Team checked the data for duplicate participants and verified the absence of such records. Similar to the Online Store component, ex-ante per-unit savings for BOL products assumed a mixed halogen and incandescent baseline. Due to market changes, we updated PY7 per bulb savings values to reflect a full halogen baseline. As a result, per-kit revised energy and demand savings were 4% lower than per-kit ex-ante savings. The Evaluation Team then applied the ISR of 67% based on PY6 evaluation efforts with BOL participants.

Table 10 shows the resulting ex-post gross savings. The BOL component saved 997 MWH and 0.09 MW, resulting in a gross savings realization rate of 64% for energy and demand savings.

Table 10. Business Office Lighting Gross Savings Summary

Component	MWH	MW
Ex-Ante Gross Savings	1,553	0.14
Revised Gross Savings	1,488	0.14
In-Service Rate	67%	
Ex-Post Gross Savings	997	0.09
Gross Savings Realization Rate*	64%	64%

* Reflects the quotient of ex-post gross and ex-ante gross savings.

The Evaluation Team applied the deemed program-specific NTGR of 0.83, based on PY5 evaluation results. As part of the PY6 evaluation, the Evaluation Team explored whether the NTGR had changed since PY5 and found that results were within the error bounds of the deemed estimate. The program therefore maintained the previously deemed NTGR based on PY5 evaluation results. Table 11 displays PY7 ex-post gross and net

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savings for the Business Office Lighting component. As can be seen in the table, this component achieved 827 MWH and 0.08 MW in ex-post net savings in PY7.

Table 11. Business Office Lighting Ex-Post Savings Summary

Component	MWH	MW
Ex-Post Gross Savings	997	0.09
NTGR	0.83	
Ex-Post Net Savings	827	0.08

Low-Income LED Mailed Kit Impacts

Review of the Low-Income LED Kit Program tracking data revealed that measure counts were accurate and complete. As part of the review, the Evaluation Team checked the data for duplicate participants and verified the absence of such records. After reviewing the program tracking data, the Evaluation Team developed revised gross savings estimates for the single LED product provided in each five-bulb kit. As with the other two lighting components, ex-ante per-unit savings per bulb assumed a mixed halogen and incandescent baseline. Due to market changes, we estimated PY7 per bulb savings using a full halogen baseline. As a result, per-kit revised energy and demand savings were 18% lower than per-kit ex-ante savings. The Evaluation Team then applied the ISR of 61% to the revised savings estimates to determine ex-post gross savings. The Evaluation Team estimated the ISR based on a survey with 240 Low-Income LED Kit recipients, which has a relative precision of 6% at 90% confidence.

Table 12 shows the resulting ex-post gross savings. The program saved 97 MWH and 0.01 MW, resulting in a gross savings realization rate of 50% for energy savings and 52% for demand savings.

Table 12. Low-Income LED Kits Gross Savings Summary

Component	MWH	MW
Ex-Ante Gross Savings	194	0.02
Revised Gross Savings	159	0.01
In-Service Rate	61%	
Ex-Post Gross Savings	97	0.01
Gross Savings Realization Rate	50%	52%

Note that the values are rounded and therefore might not sum or divide to the totals or realization rates listed in this table.

The Evaluation Team fielded a survey with free LED kit participants to establish a NTGR for this new program component in PY7. Based on responses to the survey, we estimated a NTGR of 0.95. SCE&G intended for these kits to go to low-income customers. However, survey results indicate that a mix of low-income and market rate customers received the kits. The survey found that 57% (n=207) of respondents were truly low-income. For respondents from households that fall below 150% of federal poverty guidelines, we applied a deemed NTGR of 1.0 consistent with the NTGR assumptions for the low-income customers participating in the NEEP program. Survey results suggest that, among non-low-income respondents, free ridership (FR) is 14.1% and participant spillover (SO) is 3.4%, resulting in a NTGR of 0.89 for non-low-income participants. The final NTGR of 0.95 reflects the weighted average of the 1.0 deemed NTGR for low-income participants and the 0.89 estimate for higher-income participants. Table 9 shows PY7 ex-post net savings for the Low-Income LED Kits. As can be seen in the table, the program achieved 92 MWH and 0.01 MW in net savings in PY7.

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Table 13. Low-Income LED Kits Ex-Post Savings Summary

Component	MWH	MW
Ex-Post Gross Savings	97	0.01
NTGR	0.95	
Ex-Post Net Savings	92	0.01

Carryover Savings

In addition to the first-year savings from bulbs distributed in PY7, total ex-post net savings also includes savings from bulbs distributed in prior program years that were installed in PY7. Using assumptions from the Uniform Methods Project (UMP), the Evaluation Team estimated additional net savings of 804 MWH and 0.07 MW due to carryover savings from bulbs distributed in PY5 and PY6, as shown in Table 14. Appendix A contains further detail on carryover savings calculations.

Table 14. Residential Lighting Program Carryover Savings Claimed in PY7

	Ex-Post Gross Savings		Ex-Post Net Savings	
	MWH	MW	MWH	MW
Carryover from PY5	207	0.02	154	0.01
Carryover from PY6	882	0.08	650	0.06
Total Carryover Claimed in PY7	1,089	0.10	804	0.07

Moving forward, the Evaluation Team will shift to an updated installation trajectory for bulbs distributed in PY7 or later, per the revised version of the Uniform Methods Project (UMP). Appendix A provides further detail on projected carryover savings for bulbs distributed in PY7 and in future years.

3.2 Home Energy Reports Program

3.2.1 Program Description

The Residential Home Energy Report (HER) program offers free monthly/bi-monthly reports to customers, comparing their energy usage to that of a peer group, and to their own energy usage over time. The reports also provide information to help participants identify, analyze and act upon energy efficiency upgrade opportunities and energy saving behaviors to reduce their household energy usage. The initial Home Energy Report is a customized report that provides participants with a summary of their household energy use and focuses on whole-house electricity usage. After the introductory four-page report, subsequent monthly/bimonthly Home Energy Updates compare the customers' usage to that of a peer group, promote a variety of customized energy efficiency tips and provide information about other SCE&G EnergyWise programs.

The HER Program offers three different treatment options, including a report that is mailed to the customer's home, an electronic copy that is emailed to the customer and an electronic copy that is emailed to the customer in combination with an online portal. Customers using the online portal have the option to create a Custom Action Plan, wherein they can develop personalized energy efficiency forecasts.

SCE&G program staff use an 'opt-in' model to recruit customers into the HER program. The implementer, Direct Options, purchases demographic data that corresponds with SCE&G's customer base and uses this data to select specific customers to target for program enrollment. Direct Options targets customers with

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characteristics that are likely to achieve higher savings such as high income and high rates of energy use. The number of invitations per year is dependent on attrition from the previous program year.

To enroll, SCE&G invites customers to complete an initial Home Energy Survey and set an energy savings goal. The Home Energy Survey asks details about their home, household appliances and equipment. Once complete, respondents receive the HER reports. If a customer no longer wants to receive the reports, they can cancel the reports online or contact an SCE&G customer representative. This opt-in model is distinct from other HER programs implemented across the country, as most are offered as an 'opt-out' model, where customers are defaulted into the program and continue to receive reports for years.

3.2.2 Program Performance Summary

As shown in Table 15, the program exceeded its participation forecasts while spending less than it forecasted. However, the program fell short of its energy and demand savings forecasts, primarily due to PY6 evaluation results that showed participants, on average, are reducing 1% of their annual electric usage instead of the forecasted 2%.

Table 15. HER Program Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Cost	\$731,191	\$547,389	75%
Participants (Treatment Households) *	40,991	41,324	101%
Net MWH Savings	14,810	6,296	43%
Net MW Savings	5.79	2.26	39%

*For the purpose of comparing to forecasted participation, ex-post participant counts exclude customers who opted out of the program or final billed prior to PY7.

3.2.3 Impact and Data-Tracking Findings

To determine the program's energy savings, the Evaluation Team applied average savings of 157.47 KWH and 0.056 KW per participating household in PY7. The Evaluation Team established this per-household savings value during the PY6 program evaluation by conducting an energy usage analysis which compared energy usage from program participants to similar non-participants. This approach employed an industry standard (see Uniform Methods Project) method, which matches participants with non-participant customers who are similar in terms of energy usage and other factors. The Evaluation Team conducted a linear fixed effects regression to estimate net program energy savings and then conducted a channeling analysis to avoid double-counting savings across programs.

As part of the ex-post analysis for PY7, the Evaluation Team reviewed the program participant database and found no data entry errors. However, 12 accounts were excluded from the ex-post active participant counts as they received their final bill before receiving their first report. The Evaluation Team then estimated net savings for this program by applying the average annual savings per-household to the 41,324 verified active PY7 participants. For customers who opted out of the program or moved during PY7, annual savings were prorated up to the date of final bill or opt-out. Table 16 breaks out the verified active participants by those who received prorated savings adjustments versus full-year adjustments based upon final bill or opt-out during PY7.

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Table 16. Participant Counts for HER Ex-Post Net Savings Calculations

Program Participants	Ex-Post
Total Active PY7 Participants (A)	41,324
Final Bill (B)	2,600
Opt-Out (C)	175
Participants with Prorated Savings (B+C=D)	2,775
Participants with Annual Savings (A-D)	38,549

The PY7 program achieved ex-post net savings of 6,296 MWH and 2.26 MW. Table 17 shows net adjusted program savings comparing ex-ante to ex-post. The realization rate for the program was 0.97 for MWH savings and 0.91 for MW savings. Overall, while SCE&G assigned a full year of savings to each participant, the ex-post prorated adjustments made to PY7 final bill and opt-out participants decreased the realization rates for both energy and demand savings. The realization rate for demand savings was further reduced by 6% due to a rounding error in ex-ante calculations. Specifically, ex-ante calculations used a value of 0.06 per customer, while ex-post used a more precise number based on PY6 evaluation results (approximately 0.056 KW).

Table 17. Ex-Post Net Savings Summary

HER Program	Ex-Ante	Ex-Post*	Realization Rate
Total Treatment Households	41,336	41,324	N/A
Net Adjusted Savings**			
Adjusted % Savings per Household	1.05%	1.05%	N/A
Average Adjusted Annual Savings per Household (KWH)	157.47	157.47	100%
Average Annual Savings per Household (KW)	0.060	0.056	94%
Total Program Savings			
Program Savings, All Households (MWH)	6,509	6,296	97%
Program Savings, All Households (MW)	2.48	2.26	91%

*Ex-post participants include active PY7 participants, including those who opted-out or received their final bill in PY7.

** For the purpose of the net savings calculation, a prorated adjustment is made to the annual savings calculations and applied based on the number of days enrolled for those participants who opted-out or received their final bill at some point during PY7. PY7 enrollments, however, are not prorated to reflect the opt-in nature of the program

3.3 Heating & Cooling Program

3.3.1 Program Description

The Residential Heating and Cooling Program offers rebates to SCE&G residential electric customers for installing high-efficiency air conditioners and heat pumps and improving ductwork. The program's primary goal is to assist customers with reducing electric consumption without compromising comfort in the home. To participate in the program, a customer must receive residential electric service from SCE&G in an existing separately metered residence.

Heating & Cooling New Equipment rebates are the largest component of the program and help offset the upfront cost for purchases of energy-efficient ENERGY STAR®-qualified HVAC units. The rebates vary according to HVAC type and efficiency level of the installed equipment. Table 18 summarizes the rebates offered to customers in PY7.

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Table 18. PY7 Eligible Program Measures and Rebate Amounts

Equipment Type	Minimum Efficiency Requirements	Rebate Amount
Packaged Central Air Conditioner (AC), Air-Source Heat Pump (ASHP) and Dual Fuel Heat Pump (DFHP)	15 SEER and 12 EER (and 8.2 HSPF for heat pumps)	\$200
	≥ 17 SEER and ≥ 13 EER (and ≥ 8.5 HSPF for heat pumps)	\$400
Split Central AC, ASHP and DFHP	15 SEER and 12.5 EER (and 8.5 HSPF for heat pumps)	\$200
	≥ 17 SEER and ≥ 13 EER (and ≥ 9 HSPF for heat pumps)	\$400
Duct Sealing	Duct leakage must be a 50% improvement of the existing duct leakage rate or 150 CFM reduction in leakage	\$150
Duct Insulation	Minimum insulation ≥ R-8	\$150
Complete Duct Replacement	Total leakage must be 10% or less	\$300

Notes: SEER: Seasonal Energy Efficiency Rating; EER: Energy Efficiency Rating; HSPF: Heat Seasonal Performance Factor; CFM: Cubic Feet per Minute

Customers installed more than 4,500 measures in their homes during PY7. ASHPs account for more than half (56%) of all rebated PY7 measures, followed by Central ACs (27%) and complete duct replacements (10%)². Table 19 summarizes the total number of installed PY7 measures.

Table 19. Number and Types of Measures Rebated in PY7

Measure Type		Total PY7 Measures
Heating & Cooling Equipment	Air-Source Heat Pumps (ASHPs)	2,553
	Central Air Conditioners (Central ACs)	1,232
	Dual-Fuel Heat Pumps (DFHPs)	5
	Total HVAC	3,790
Ductwork	Complete Duct Replacements	462
	Duct Sealing	74
	Duct Insulation	195
	Total Ductwork	731
Total Program Measures		4,521

3.3.2 Program Performance Summary

In PY7, SCE&G reported that the Heating and Cooling Program installed 90% of the planned number of measures, while spending 103% of the budget. The program achieved 3,930 MWH of ex-post gross energy savings and 2.75 MW of ex-post gross demand savings, exceeding energy and demand savings goals by 263% and 262%, respectively. The realization rates for this program (ex-post vs. ex-ante) were approximately 100% in PY7. However, the program nearly doubled its savings forecast as the forecast was based on conservative

² SCE&G introduced a new duct-blaster test requirement for duct sealing and duct replacements to align with state building codes. However, many contractors are not complying but still attempting to submit paperwork for the incentive when replacing a complete duct system. SCE&G is responding by issuing these customers a duct insulation rebate amount because they cannot produce the required test results. Therefore, in PY7, records may indicate that many customers received duct insulation when, in fact, they may have completely replaced their ducts. The records will, therefore, likely underestimate the savings from ductwork. However, the Evaluation Team cannot credit the savings for these duct replacements without at least a sample of projects that prove to pass the duct-blaster test.

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savings values. Table 20 summarizes the PY7 forecasts and overall results for the program in terms of cost, participation and energy and demand savings.

Table 20. Heating and Cooling Program Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Cost	\$1,428,608	\$1,474,174	103%
Measures	5,000	4,521	90%
Gross MWH Savings	1,497	3,930	263%
Gross MW Savings	1.05	2.75	262%
Net MWH Savings	N/A	2,212	N/A
Net MW Savings	N/A	1.36	N/A

Heating & Cooling Equipment was the largest component of the program in terms of both energy savings (78%) and measures rebated (84%). Table 21 shows total ex-post gross savings, participants and measures rebated by program component.

Table 21. Heating and Cooling Program Population Size

Program Component	Ex-Post Gross Savings (MWH)	Number of Participants	Number of Measures
Heating & Cooling Equipment	3,081	3,434	3,790
Ductwork	849	684	731
Total	3,930	4,118	4,521

3.3.3 Impact and Data-Tracking Findings

Table 22 presents the total ex-ante and ex-post gross savings for each program component. The overall realization rate for the program was 1.003 for MWH and .73 for MW savings. The difference in demand savings was due to an ex-ante reporting error from the tracking database for heating and cooling equipment given that database records did calculate 2.47 instead of the ex-reported value of 3.47. Although the Evaluation Team identified differences in energy savings assumptions, the impact on overall program savings was negligible (<0.5%).

Table 22. Heating and Cooling Program Ex-Ante vs. Ex-Post Gross Savings Summary

Program Component	Ex-Ante Gross Savings		Ex-Post Gross Savings		Realization Rate	
	MWH	MW	MWH	MW	MWH	MW
Heating & Cooling Equipment	3,065	3.47	3,081	2.47	101%	71%
Ductwork	852	0.28	849	0.28	100%	100%
Total	3,917	3.75	3,930	2.75	100.3%	73%

Table 23 shows the program achieved ex-post net savings of 2,212 MWH and 1.36 MW. The Evaluation Team applied NTGRs from the PY6 Heating & Cooling Equipment and PY3 Ductwork evaluations to ex-post gross savings to calculate the total program net savings.

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Table 23. Heating and Cooling Program Ex-Post Net Savings Summary

Program Component	Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
	MWH	MW	MWH	MW	MWH	MW
Heating & Cooling Equipment	3,081	2.47	55%	48%	1,694	1.19
Ductwork	849	0.28	61%	62%	518	0.17
Total	3,930	2.75	56%	49%	2,212	1.36

In the following sections, the Evaluation Team provides details on impact findings for each program component.

Heating & Cooling Equipment Impact Findings

Verified Measure Quantity

The Evaluation Team first reviewed the program database to verify the total number of rebated measures. The Evaluation Team found no duplicate records or database errors within the program database and, therefore, did not adjust ex-ante measure quantities. Table 24 shows the resulting verified ex-post measure quantity is equal to the ex-ante measure quantity.

Table 24. Number of Heating & Cooling Equipment Measures Rebated

Measure	Ex-Ante Quantity	Verified Ex-Post Quantity
ASHP	2,553	2,553
Central AC	1,232	1,232
DFHP	5	5
Total	3,790	3,790

Ex-Post Gross Deemed Savings

The Evaluation Team developed per-ton deemed savings values as part of the PY6 evaluation to apply in PY7. Both ex-ante and ex-post savings calculations applied these values to determine overall PY7 savings for Heating & Cooling Equipment measures. The Evaluation Team verified that ex-ante savings applied the correct deemed values, except for cases where the deemed value was unavailable. Specifically, SCE&G did not have an evaluated deemed value for measures new to PY7 (e.g., 21 SEER Central AC). For these cases, ex-ante applied the available deemed savings value that most closely aligned with the measure type (e.g., applied per-ton deemed savings for a 20 SEER Central AC to a rebated 21 SEER Central AC), whereas the Evaluation Team calculated and applied a new deemed savings value for each new PY7 measure. In most cases, ex-ante applied a deemed savings value for a lower efficiency unit than the actual installed efficiency, thus understating savings, and therefore resulting in slightly higher ex-post energy savings. Table 76 in Appendix B provides the PY7 deemed savings values for all Heating & Cooling Equipment measures.

Overall, in PY7, Heating & Cooling Equipment achieved ex-post gross savings of 3,081 MWH and 2.47 MW. The program realization rates for energy and demand are 101% and 71%, respectively. The realization rate for demand savings was driven by an ex-ante reporting error. Table 25 compares the total ex-ante and ex-post gross savings by equipment type.

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Table 25. Total Ex-Ante and Ex-Post Gross Savings for Heating & Cooling Equipment

Measure Type	Verified Quantity	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
		MWH	MW	MWH	MW	MWH	MW
ASHP	2,553	2,500	0.00	2,510	2.00	1.00	N/A
Central AC	1,232	560	0.00	566	0.47	1.01	N/A
DFHP	5	5	0.00	5	0.004	1.00	N/A
Total	3,790	3,065	3.47	3,081	2.47	1.01	.71

Note: Totals may not sum or multiply precisely due to rounding.

Net Impacts

In PY7, the program achieved ex-post net savings of 1,694 MWH and 1.19 MW. Based on PY6 evaluation results, the Evaluation Team applied NTGRs of 0.55 for energy savings and 0.48 for demand savings to calculate the total net savings. These NTGRs indicate that the program had a moderate influence on customer decisions to installed systems that are more energy efficient than SEER 14s and lead SCE&G to adjust rebate tiers and increase rebate amounts in PY8. Table 26 summarizes the total net impacts by equipment type.

Table 26. Net Impacts for Heating & Cooling Equipment

Measure Type	Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
	MWH	MW	MWH	MW	MWH	MW
ASHP	2,510	2.00	0.55	0.48	1,380	0.96
Central AC	566	0.47			311	0.23
DFHP	5	0.004			3	0.002
Total	3,081	2.47	0.55	0.48	1,694	1.19

Note: Totals may not sum or multiply precisely due to rounding

Ductwork Impact Findings

Verified Measure Quantity

The Evaluation Team first reviewed the program database to verify the total number of rebated measures. The Evaluation Team found 13 potentially duplicate records for ductwork measures within the program database but confirmed with SCE&G that all identified projects received multiple ductwork measures and are not duplicates. Therefore, the Evaluation Team made no adjustments to the ex-ante measure quantities. Table 27 shows the resulting verified ex-post measure quantity is equal to the ex-ante measure quantity.

Table 27. Number of Ductwork Measures Rebated

Measure	Ex-Ante Quantity	Verified Ex-Post Quantity
Complete Duct Replacement	462	462
Duct Sealing	74	74
Duct Insulation	195	195
Total	731	731

Ductwork deemed savings values are applied per-ton. There are 163 (22%) ductwork measures where the HVAC size (i.e., tonnage) is unknown. The Evaluation Team calculated and applied an average (3.03 tons) to

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these records using actual tonnages specified in the PY7 database³. Ex-ante savings applied the average tonnage from PY6 (3.07 tons), which is 1.3% larger than the average tonnage using PY7 data. Although there are differences in ex-ante and ex-post assumptions for measures with unknown capacities, the impact on savings is minimal (<0.5%). Table 28 compares the total ex-ante and ex-post tons by measure type.

Table 28. Ex-Ante and Ex-Post Total Capacity (Tons) Comparison

Measure	Ex-Ante Capacity (Tons)	Ex-Post Capacity (Tons)	% Decrease
Duct Sealing	232	231	- 0.47%
Duct Insulation	586	584	- 0.39%
Complete Duct Replacement	1,401	1,397	- 0.23%
Total	2,218	2,211	- 0.30%

Ex-Post Gross Savings

Both ex-ante and ex-post savings calculations applied the per-ton deemed savings values established in PY5 to determine overall PY7 savings for ductwork measures. The Evaluation Team verified that ex-ante savings applied the correct deemed values for all program measures Table 77 provides the PY7 deemed savings values for all ductwork measures.

In PY7, ductwork measures achieved total ex-post gross savings of 849 MWH and 0.28 MW. The program realized 100% of its ex-ante energy and demand savings. Table 29 summarizes the total ex-ante and ex-post gross savings by equipment type.

Table 29. Ex-Ante and Ex-Post Gross Savings for Ductwork

Measure Type (and HVAC System Type)	Verified Quantity	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
		MWH	MW	MWH	MW	MWH	MW
Complete Duct Replacement (Heat Pump)	240	442	0.11	442	0.11	1.00	1.00
Complete Duct Replacement (AC)	222	232	0.11	231	0.11	1.00	1.00
Duct Sealing (Heat Pump)	38	44	0.01	42	0.01	0.95	0.95
Duct Sealing (AC)	36	26	0.01	25	0.01	1.00	1.00
Duct Insulation (Heat Pump)	98	74	0.02	74	0.02	1.00	1.00
Duct Insulation (AC)	97	35	0.02	35	0.02	1.00	1.00
Total	731	852	0.28	849	0.28	1.00	1.00

Note: Totals may not sum or multiply precisely due to rounding.

Net Impacts

In PY7, the program achieved ex-post net savings of 518 MWH and 0.17 MW. The Evaluation Team applied PY3-evaluated NTGRs (0.61 for energy savings and 0.62 for demand savings) to calculate the total net savings. Table 30 summarizes the total net impacts by equipment type.

³ The average tonnage included PY7 data for those with known HVAC capacities, including 573 (78%) of the 731 ductwork measures.

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Table 30. Net Impacts for Ductwork

Measure Type (and HVAC System Type)	Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
	MWH	MW	MWH	MW	MWH	MW
Complete Duct Replacement (Heat Pump)	442	0.11	0.61	0.62	269	0.07
Complete Duct Replacement (AC)	231	0.11			141	0.07
Duct Sealing (Heat Pump)	42	0.01			26	0.01
Duct Sealing (AC)	25	0.01			16	0.01
Duct Insulation (Heat Pump)	74	0.02			45	0.01
Duct Insulation (AC)	35	0.02			21	0.01
Total	849	0.28	0.61	0.62	518	0.17

Note: Totals may not sum or multiply precisely due to rounding.

3.4 Home Energy Check-Up Program

3.4.1 Program Description

The Residential Home Energy Check-Up (HEC) Program provides electric customers in SCE&G's service territory with a home visit that includes a visual inspection of the home and an energy consultation with the customer. During the check-up, an SCE&G representative, who is certified as a Building Analyst Professional through the Building Performance Institute (BPI), identifies sources of high energy use, reviews up to two years of consumption data and weather impacts and discusses energy-saving behaviors with the customer (e.g., thermostat settings, water heater settings, etc.). In addition, they provide the customer with free ("leave-behind") measures (Table 31) and a list of "10 Ways to Save" that suggests energy saving actions (Table 32). In mid-PY7, SCE&G discontinued its offering of a lighting kit with four CFLs and one LED and transitioned to a kit that includes five LED bulbs. Also new to PY7, SCE&G provided direct installation of kitchen faucet aerators for a subset of HEC participants and updated the recommended measures list to suggest replacing lights with ENERGY STAR® LEDs instead of CFLs.

Program-Specific Findings

Table 31. Leave-behind Measures Offered through the HEC Program

Leave-behind Measure
Kit of five LED bulbs (three 10-Watt, one 12-Watt and one 14-Watt)
Kit of four CFLs (two 18-Watt, one 23-Watt, one 13-Watt) and one 9-Watt LED
Hot water pipe insulation (6 feet), as appropriate
Electric water heater insulating blanket, as appropriate
Kitchen Faucet Aerator (direct install), as appropriate

Note: measures were leave-behind except where noted

Table 32. Energy Conservation Actions Recommended during the HEC Home Visit

Recommended Measure
Adjust water heater temperature to 120°F
Caulk, seal and weather-strip windows or doors
Replace air filters
Have central heating and cooling system serviced
Install a programmable thermostat
Replacing incandescent lamps with ENERGY STAR® LEDs
Leave interior doors open and keep vents open for adequate air flow
Repair ducts
Set thermostat at 68°F or lower in the winter and 78° F or higher in the summer
Unplug appliances, lights, TVs, computers, etc. when not in use
Upgrade attic insulation to a minimum of R-38

Note: Program materials further recommend visiting SCE&G's website or calling SCE&G.

3.4.2 Program Performance Summary

In PY7, the program fell slightly short of expected participation targets and, as a result, fell short of its demand savings goals. However, despite lower-than-expected participation, the program slightly exceeded energy savings goals due to larger savings per-participant than forecasted. Table 33 summarizes the forecasts and actuals in terms of costs, participation and energy and demand savings.

Table 33. Home Energy Check-Up Program Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Costs	\$804,981	\$692,026	86%
Participants	3,263	2,880	88%
Gross MWH	2,177	2,311	106%
Gross MW	0.44	0.37	84%
Net MWH	N/A	1,821	N/A
Net MW	N/A	0.28	N/A

The program performed check-ups for 2,880 residential customers during PY7. The lighting kit with four CFLs and one LED was the most common measure provided (50% of participants), followed by the all LED lighting kit (just under half at 48%). A small portion of participants (2%) received a check-up but did not receive any

Program-Specific Findings

leave-behind measures. Table 34 summarizes program participation by each of the measures offered through HEC.

Table 34. Home Energy Check-Up Program Participation by Leave-behind Measure

Measure	Number of Participants Who Received Measure	% of Total Participants (n=2,880)	Total Measures Provided in PY7
Kit of 4 CFLs & 1 LED	1,426	50%	1,426 kits
Kit of 5 LEDs	1,385	48%	1,385 kits
Hot Water Pipe Insulation	449	16%	2,694 feet
Electric Water Heater Insulating Blanket	529	18%	529 blankets
Kitchen Faucet Aerator	90	3%	90 aerators
Additional Kit of LEDs	4	0.1%	20 LED bulbs

Note: Measure totals do not sum to 2,880 because participants were given multiple measures.

3.4.3 Impact and Data-Tracking Findings

Database Review

Table 35 shows the number of measures tracked in the program database and verified as installed. The Evaluation Team noted only one minor discrepancy in the program tracking database. Specifically, four customers who received a kit of four CFLs and one LED were each provided five additional LED bulbs after their initial Home Energy Check-up. This discrepancy did not change ex-ante measure counts or total participants.

Next, the evaluation team applied installation rates to ex-ante measure quantities to determine ex-post measure quantities (Table 35).

Table 35. Home Energy Check-Up Program Leave-behind Measure Verification

Measure	Participants Who Received Measure	Ex-Ante Measure Quantity	Installation Rate	Ex-Post Measure Quantity	Unit
Kit with 4 CFLs & 1 LED	1,426	1,426	N/A*	1,426	Household
Kit with 5 LEDs	1,385	1,385	N/A*	1,385	Household
Faucet Aerators	90	90	1.00	90	Aerators
Additional Kit of LEDs	4	4	0.79	3	Kits

*Installation rate incorporated into deemed savings calculation

Note: May not multiply precisely due to rounding.

Program-Specific Findings

Ex-Post Gross Savings for PY7 Participants

To calculate ex-post gross savings, the Evaluation Team applied deemed savings values to ex-post measure quantities. As shown in Table 36, the program achieved ex-post gross savings of 2,218 MWH and 0.36 MW from PY7 participants. Note that the total PY7 claimed savings for this program are higher than what is shown in the table below because the evaluation accounted for PY5 and PY6 carryover savings (see Table 39). More detail on the calculation of ex-post gross savings is provided following the table.

Table 36. PY7 Ex-Post Gross Savings

Program Component	Ex-Post Measure Quantity	Unit	Savings per Unit		Ex-Post Gross Savings	
			KWH	KW	MWH	MW
Kit with 4 CFLs & 1 LED	1,426	Household	765.80	0.13	1,092	0.18
Kit with 5 LEDs	1,385	Household	797.65	0.13	1,105	0.18
Faucet Aerators	90	Aerators	225.00	0.01	20	0.001
Additional Kit of LEDs	3	Kits	216.81	0.02	1	0.0001
Total					2,218	0.36

Note: May not sum or multiply precisely due to rounding.

Kit with 4 CFLs & 1 LED

There were 1,426 customers who received a kit of four low-wattage CFLs and one LED bulb. Among this group, 253 customers also received electric water heater insulating blankets and 223 received hot water pipe insulation (total of 1,338 feet). The Evaluation Team applied PY6-evaluated installation rates of 70% for the lighting measures and 69% for both the water heater blankets and pipe insulation. Applying per-measure deemed savings values to each of the verified quantities resulted in a total savings of 276 MWH and 0.03 MW. The Evaluation Team also included 572 KWH and 0.11 KW of recommended measure savings to each participant, evaluated in PY6. This brought the total ex-post gross savings for installed and recommended measures to 1,092 MWH and 0.18 MW. Dividing by total participants who received the kit, the final per-household deemed savings value was 766 KWH and 0.13 KW. Please see Table 78 in Appendix C for more detail on the per household calculation.

Kit with 5 LEDs

There were 1,426 customers who received a kit of five LED bulbs. Among this group, 262 customers also received electric water heater insulating blankets and 210 received hot water pipe insulation (total of 1,260 feet). The Evaluation Team applied PY6-evaluated installation rates of 79% for the LEDs and 69% for both the water heater blankets and pipe insulation. Applying per-measure deemed savings values to each of the verified quantities resulted in a total savings of 315 MWH and 0.03 MW. The Evaluation Team also included 572 KWH and 0.11 KW of recommended measure savings to each participant, evaluated in PY6. This brought the total ex-post gross savings for installed and recommended measures to 1,108 MWH and 0.18 MW. Dividing by total participants who received the kit, the final per-household deemed savings value was 798 KWH and 0.13 KW. Please see Table 79 in Appendix C for more detail on the per household calculation.

Faucet Aerators

The program provided direct installation of kitchen faucet aerators to 90 customers. A 100% installation rate was applied based on a review of assumptions used for the seven states that directly install kitchen faucet

Program-Specific Findings

aerators.⁴ The Evaluation Team applied a per-measure savings value of 225 KWH and 0.011 KW based on a PY7 engineering analysis.⁵ This resulted in ex-post gross savings of 20 MWH and 0.001 MW.

Additional LEDs

In the process of verifying participant and measure counts for PY7, the Evaluation Team identified four participants that received kits with five additional LEDs each after receiving a kit with four CFLs and one LED during the initial home visit. The Evaluation Team applied a deemed savings value of 217 KWH and 0.02 KW for each kit of additional LEDs. Given the 79% installation rate for LEDs per PY6 survey results, the verified quantity of additional LED kits was three, resulting in ex-post gross savings of 1 MWH and 0.0001 MW.

Program Ex-Post Gross Savings Summary

The program achieved gross realization rates of 0.88 for MWH and 0.76 for MW savings, resulting in ex-post gross savings of 2,311 MWH and 0.37 MW (see Table 37). The realization rates are primarily driven by differences in average per-household savings for installed lighting measures. SCE&G's applied an ex-ante per-household value that was based on PY4 evaluation results and assumed a lighting kit savings of approximately 300 KWH per-household. Evaluated savings for PY7, however, were approximately 200 KWH per-household due to updates to the lighting measures being offered (i.e., kits containing one or five LEDs), as well as reduced per-bulb savings from EISA-related baseline adjustments. These factors both contributed to the overall lower per-household savings value.

Table 37. HEC Program Ex-Post Gross Savings Summary

Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
MWH	MW	MWH	MW	MWH	MW
2,612	0.49	2,311	0.37	0.88	0.76

Note: Values rounded for reporting purposes.

Net Verified Savings for PY7 Participants

The Evaluation Team applied NTGRs of 0.79 (MWH) and 0.74 (MW) to the total ex-post gross savings to arrive at the total program net savings. The PY7 NTGRs are based on PY6 participant survey results. Table 38 summarizes the total net savings for PY7 participants. The program achieved ex-post net savings of 1,752 MWH and 0.27 MW.

⁴ The following technical reference manuals (TRMs) were used to develop the faucet aerator installation rate: Massachusetts TRM (2013), Maine (2016), Pennsylvania (2016), Rhode Island TRM (2015), Iowa Vol 2 TRM, Illinois TRM (V6), and Indiana TRM (V2.2). The average across these seven sources is 99% (five of the seven sources were 100% ISRs and two of the TRMs, referencing the same study, were 95%)

⁵ As documented in March 2nd, 2017 Memorandum: Estimated Energy and Demand Savings for Low-Flow Faucet Aerators in SCE&G Territory

Table 38. Home Energy Check-Up Program Gross and Net Savings for PY7 Participants

Ex-Post Gross Savings		NTG Ratio		Net Savings	
MWH	MW	MWH	MW	MWH	MW
2,218	0.36	0.79	0.74	1,752	0.27

Total Net Savings to Claim in PY7

Total net savings that can be claimed in PY7 are slightly higher than savings only from PY7 participants, as it also includes savings from leave-behind CFLs and LEDs from prior program years that were installed in PY7. Using assumptions from the Uniform Methods Project (UMP), the Evaluation Team estimated that 2,646 CFLs from either PY5 or PY6 were installed in PY7 and that 159 LEDs from PY6 were installed in PY7. As shown in Table 39, this resulted in 70 MWH and 0.006 MW of additional net savings. See Appendix C for more detailed carryover savings calculations.

The table also compares the PY7 ex-ante savings to the ex-post savings established through this evaluation. Overall, both ex-post gross and net savings are less than ex-ante. SCE&G estimated ex-ante savings using per-participant savings from the PY4 evaluation. In PY7, the evaluation applied new gross savings per participant that are lower than PY4 due to the Energy Independence and Security Act (EISA)'s effects on the lighting baseline.

Table 39. Total Savings Claimed in PY7

Program Year	Gross Savings		Net Savings*	
	MWH	MW	MWH	MW
Ex-Ante PY7 (A)	2,612	0.49	2,064	0.36
Ex-Post Total Carryover Savings Claimed in PY7 (B)	93	0.008	70	0.006
Ex-Post PY7 Participants (C)	2,218	0.36	1,752	0.27
Total Ex-Post Savings Claim for PY7 (B+C=D)	2,311	0.37	1,821	0.28
Realization Rate (D/A)	0.88	0.76	0.88	0.76

*Net savings take into account the PY5 NTGR for PY5 leave-behind CFLs (0.68 for electric energy savings and 0.78 for demand savings) as well as the PY6 NTGR for PY6 leave-behind CFLs and LEDs (0.79 for electric energy savings and 0.74 for demand savings)

3.5 Neighborhood Energy Efficiency Program

3.5.1 Program Description

The Neighborhood Energy Efficiency Program (NEEP) provides income-qualified residential customers with an in-home energy assessment of their home and low-cost energy-saving measures at no cost to the customer. SCE&G delivers the program using a neighborhood door-to-door sweep approach and directly installs a variety of energy efficiency measures for customers. SCE&G delivers the program to neighborhoods where approximately half of the households have income levels equal to or less than 150% of the 2012 poverty guideline, as defined by the federal government. Honeywell assisted SCE&G as the program implementer providing in-home services to customers.

During the home visits, the SCE&G representative conducts a walkthrough of the home and makes recommendations for additional ways to save energy. Depending on their needs, participants received various measures (see "Core" measures in Table 40). New to PY7, the program transitioned from CFL to LED bulbs

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and added kitchen faucet aerators. The program also continued to offer the “Mobile Home” measure component that was first introduced in PY6. Table 40 lists the measures provided through the program. Notably, most mobile home customers received Core measures as well as Mobile Home component measures.

Table 40. NEEP Measures

Measure/Action	
Core Program Measures	Mobile Home Measures/Offering
CFLs (various wattages)	Air Sealing (various levels of leakage reduction)
LEDs (various wattages)	Attic Plug & Fill Insulation (> R-30)
HVAC Filters (various sizes)	Belly Board Insulation (> R-19)
Smart-Strips	Belly Board Repair
Water Heater Pipe Wraps (1–6 feet)	Digital Switch Plate Wall Thermometer
Water Heater Blankets	Duct Sealing with > 10% Reduction
Window/Wall AC Winterization Kits* (various sizes)	Programmable Communicating Thermostat
Kitchen Faucet Aerators	Reflective Roof Coating
Water Heater Temperature Adjustment	CO Monitor

*The “kit” is an in-door cover for the unit with sealing tape.

Customers also receive a list of tips for saving energy, which encourages them to take additional energy conservation actions following the representative’s visit, and a checklist of installed measures detailing the benefits of each measure added to their home. Table 41 presents the recommended energy conservation actions on this list.

Table 41. NEEP Energy Conservation Actions Recommended on the List of Tips

Recommended Measure
Adjust water heater temperature to 120°F
Caulk, seal and weather-strip windows or doors
Replace air filters
Have central heating and cooling system serviced
Install a programmable thermostat
Replacing incandescent lamps with ENERGY STAR® LEDs
Leave interior doors open and keep vents open for adequate air flow
Repair ducts
Set thermostat at 68° F or lower in the winter and 78° F or higher in the summer
Unplug appliances, lights, TVs, computers, etc. when not in use
Upgrade attic insulation to a minimum of R-38

Note: Program materials further recommend visiting SCE&G’s website or calling SCE&G.

3.5.2 Program Performance Summary

The program performed well in PY7, spending roughly 30% more than initially budgeted, but exceeding participation, energy and demand savings forecasts. The program exceeded savings forecasts mainly because SCE&G exceeded its participation forecast and partly because forecasted numbers did not include the Mobile Home component measures. Table 42 summarizes the forecasted and actual results in terms of costs, participation and energy and demand savings.

Program-Specific Findings

Table 42. NEEP Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Cost	\$863,126	\$1,129,404	131%
Participants	2,000	3,104	155%
Gross MWH Savings	2,010	3,637	181%
Gross MW Savings	0.33	0.38	115%
Net MWH Savings	N/A	3,637	N/A
Net MW Savings	N/A	0.38	N/A

The program performed in-home energy assessments for 3,104 residential customers. The majority received direct install measures while 80 customers also received weatherization measures targeted to mobile homes.

Table 43: NEEP Participation by Program Type

Program Component	Number of Participants	% of Total Participants
Core Program - Direct install measures	3,024	97%
Mobile home weatherization + direct install	77	2%
Mobile home weatherization only	3	<1%
Total Program Participants	3,104	100%

The program offered nine different Core program measures to customers, with the three most common measures being LEDs, HVAC filters (typically a set of 12)⁶ and smart-strips. SCE&G chose which measures to install based on customer need and, on average, customers received four of the nine available measures. No customers received all nine Core measures.

The program offered nine different Mobile Home measures, with the three most common measures being digital switch plate wall thermometers, air sealing and duct sealing. On average, mobile home customers received four of the nine available measures. There were no mobile home participants who received all nine measures. Table 44 presents measure counts and the number of customers broken out by Core and Mobile Home measures.

Table 44. NEEP Participation by Component and Measure

Measure	Program Participants	% of Total Participants*	Total Measures Given in PY7**	Unit
Core Program Measures				
HVAC Filters	2,758	89%	32,896	Filters
LEDs	2,698	87%	33,370	Lamps
Smart-Strips	2,341	75%	2,341	Strips
Aerators	2,147	69%	2,147	Aerators
Water Heater Pipe Wraps (1 foot)	1,007	32%	4,770	Feet
Water Heater Blanket	994	32%	994	Blankets
Water Heater Temperature Adjustment	461	15%	461	Adjustments

⁶ The SCE&G staff installed the first HVAC filter and typically provided an additional 11 replacement filters, instructing the customer to replace the filter on a monthly basis.

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Measure	Program Participants	% of Total Participants*	Total Measures Given in PY7**	Unit
CFLs	393	13%	5,409	Lamps
Window/Wall AC Winterization Kits	35	1%	63	Kits
Mobile Home Measures				
Digital Switch Plate Wall Thermometer	80	100%	80	Thermometers
Duct Sealing with > 10% Reduction	79	99%	79	Participants
Air Sealing > 30% Leakage Reduction	46	58%	46	Participants
Air Sealing > 40% Leakage Reduction	34	43%	34	Participants
Attic Plug & Fill Insulation (R-30)	27	34%	29,922	Square Feet
Programmable Communicating Thermostat	8	10%	8	Thermostats
Reflective Roof Coating	6	8%	7,004	Square Feet
Belly Board Repair	4	5%	795	Square Feet
CO Monitor	2	3%	2	Monitors
Total	3,104	N/A	120,421	

*% of Total Participants is calculated by dividing the number of participants who received the measure by the number of unique NEEP participants (n=3,104 for Core Program Measures and n=80 for Mobile Home Measures).

**Does not account for persistence rates.

3.5.3 Impact and Data-Tracking Findings

Ex-Post Gross Savings Adjustments (Core Measures)

The Evaluation Team reviewed the program database and found no duplicate records. However, we found several discrepancies between ex-ante savings estimates and the agreed upon deemed savings for PY7, primarily for lighting measures. Aside from slight rounding errors, the sources of discrepancies are detailed below by measure type:

- **CFLs:** SCE&G used PY4-evaluated deemed savings values whereas the Evaluation Team used PY7-recommended values.
- **LEDs:** These measures were new to the program in PY7 and therefore had no PY7-recommended deemed savings values that SCE&G could apply. SCE&G therefore utilized deemed savings values from the Residential Lighting program. However, in the case of the 60W, 75W and 100W equivalent LEDs, PY4-evaluated savings were applied instead of PY7-recommended Residential Lighting deemed savings values. In the case of the 40W equivalent LED, the PY7-recommended deemed savings values for a candelabra LED were used. However, the lighting measure distributed through the NEEP program was a 40W equivalent standard LED bulb and not a candelabra. The Evaluation Team updated these values to PY7-recommended values.
- **HVAC Filters (Cooling Only):** The PY7-recommended deemed savings values for HVAC filters were 32 KWH and 0.015 KW, but SCE&G applied PY6 values of 30 KWH and 0.018 KW.

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The differences due to small rounding errors or the application of incorrect savings values resulted in increased KWH savings but reduced KW savings. For lighting measures, the Evaluation Team applied an 'existing conditions' baseline assumption instead of an EISA-adjusted baseline. Based on program staff records that track the bulbs types that are replaced with efficient lighting, the 'existing conditions' baseline for CFLs and LEDs is an incandescent bulb, instead of a halogen, as that is the predominant bulb-type that program staff replaces with energy efficient bulbs. However, the Evaluation Team will continue to conduct research in PY8 to determine whether the 'existing condition' baseline is still an incandescent. Table 45 compares the per-unit ex-ante and ex-post deemed savings estimates for each measure.

Table 45. NEEP Comparison of Ex-Ante and Ex-Post Savings Values For Core Measures (Per-Unit)

Measure Description	Unit	Ex-Ante		Ex-Post		% Difference		Reason for Difference
		KWH	KW	KWH	KW	KWH	KW	
CFL 9W Spiral	Per lamp	27.92	0.003	33.90	0.003	121%	100%	Ex-ante applied deemed savings values that used a halogen (instead of incandescent) wattage baseline
CFL 13W Spiral	Per lamp	42.16	0.004	51.50	0.005	122%	125%	
CFL 20W Spiral	Per lamp	38.54	0.004	60.20	0.006	156%	150%	
CFL 23W Spiral	Per lamp	53.66	0.005	56.90	0.005	106%	100%	
LED 40W Equivalent	Per lamp	38.33	0.004	37.23	0.003	97%	85%	
LED 60W Equivalent	Per lamp	45.44	0.004	54.75	0.005	120%	122%	
LED 75W Equivalent	Per lamp	44.35	0.004	68.99	0.006	156%	154%	
LED 100W Equivalent	Per lamp	45.68	0.004	94.17	0.009	206%	205%	
HVAC Filters (Heating & Cooling)	Per participant	64	0.015	64.00	0.015	100%	100%	N/A
HVAC Filters (Cooling Only)	Per participant	30	0.018	32.00	0.015	107%	83%	Ex-ante applied incorrect deemed savings values
Kitchen Faucet Aerator	Per Aerator	225	0.011	225.00	0.011	100%	100%	N/A
Pipe Wrap 1 foot	Per foot	13.72	0.002	13.72	0.002	100%	78%	Rounding
Smart-Strip	Per strip	102.8	0.012	102.80	0.012	100%	100%	N/A
Water Heater Blanket	Per blanket	360.8	0.041	360.80	0.041	100%	100%	N/A
Winterization - Large	Per kit	46.86	0	46.86	0	100%	100%	Rounding
Winterization - Medium	Per kit	34.35	0	34.35	0	99.99%	100%	Rounding
Winterization - Small	Per kit	23.16	0	23.16	0	99.98%	100%	Rounding
Water Heater Temperature Adjustment	Per WH	113.84	0.013	113.84	0.013	100%	99.97%	Rounding

As shown Table 46, ex-post results for PY7 apply persistence rates developed using the PY5 evaluation results. However, for core measures new to PY7 (i.e., LEDs and Kitchen Faucet Aerators), no persistence rates were applied as they have not yet been evaluated. The Evaluation Team plans to develop a persistence rate for these measures in the future program years using updated survey results.

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Table 46. NEEP Persistence Rates by Core Measure

Measure	Persistence Rate	Source
CFLs	99.9%	PY5 Evaluation Results
Smart-Strip	93%	
Water Heater Pipe Wrap (1 foot)	94%	
Window/Wall AC Winterization Kit	95%	
Water Heater Blanket	92%	
Water Heater Temperature Adjustments*	100%	

*For water heater temperature adjustments, a “removed measure” means that a customer raised or lowered his/her water heater temperature after program staff set the water heater temperature to 120 °F.

Note: Persistence rates were not applied for filters, as the SCE&G representative installed the first filter and asked the customer to replace filters monthly.

Ex-Post Gross Savings Adjustments (Mobile Home Measures)

The Evaluation Team reviewed the Mobile Home program database and found no errors or duplicate records. However, we did find that ex-ante reported participation for the NEEP program did not include the mobile home participants. The Evaluation Team used the measure-specific data within the PY7 Mobile Home database to derive an average ex-post per-home savings value. This value was applied to all 80 participating mobile homes to arrive at the overall ex-post savings for mobile homes. Table 47 compares the ex-ante and ex-post per-home savings values.

Table 47. Ex-Ante and Ex-Post Average per Mobile Home Savings Comparison

Measure Description	Ex-Ante Gross Savings		Ex-Post Gross Savings	
	KWH	KW	KWH	KW
Average Savings per Mobile Home	1,377	0.390	1,705	0.470

Ex-ante applied the PY6 ex-post per-mobile home savings values to calculate the total PY7 ex-ante mobile home savings. However, we found that the PY6 and PY7 ex-post per-home savings vary for two reasons:

- **Increased Measure Quantity and Program Participation:** We found that on average the total number of installed measure quantities in PY7 increased by 51% and participation increased by 60% compared to PY6. As a result, we expected a higher per-home savings value in PY7 compared to the ex-post per-home value calculated in PY6.
- **Assumed Heating Fuel and Equipment Types:** PY6 relied on Residential Energy Consumption Survey (RECS) census data assuming 83% of participants have cooling present and 65% have electric heating. PY7 relied on data within the program-tracking database, resulting in 96% of participants with cooling present and 83% of participants with electric heating. This suggests that SCE&G’s territory may be unique from other territories in this regard. As a result of the higher percentage of participants with electric heating and cooling in PY7, ex-post savings estimates increased.

Refer to Appendix D for a more detailed description of ex-post savings methodologies and discrepancies between ex-ante and ex-post gross savings.

Program-Specific Findings

Ex-Post Gross Impacts

Table 48 presents ex-ante and ex-post gross savings by measure and program component. The overall realization rate for the program was 1.17 for MWH savings and 1.23 for MW savings. Changes to the baseline wattage of LED bulbs in particular are the primary driver of the high realization rates, as they represent more than half (52%) of ex-post gross program savings. Furthermore, correcting a calculation error for kitchen faucet aerators substantially increased the realization rate. Mobile home measures further provided a small additional boost to overall savings while the application of persistence rates slightly reduced savings for some core measures.

Table 48. Gross Realization Rates for NEEP

Measure	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
	MWH	MW	MWH	MW	MWH	MW
Core Measures						
LEDs	1,515	0.137	1,901	0.174	1.25	1.27
Aerators*	373	0.002	483	0.024	1.29	12.0
Water Heater Blanket	359	0.041	330	0.037	0.92	0.92
CFLs	230	0.022	282	0.027	1.23	1.25
Smart-Strips	241	0.028	224	0.026	0.93	0.93
HVAC Filters	164	0.042	165	0.041	1	0.97
Water Heater Pipe Wraps (1 foot)	65	0.01	62	0.007	0.94	0.74
Water Heater Temperature Adjustment	52	0.006	52	0.006	1	1
Window/Wall AC Winterization Kits	2	0	2	0	0.95	N/A
Core Measures Subtotal	3,001	0.288	3,501	0.343	1.31	1.19
Mobile Homes	110	0.031	136	0.038	1.24	1.23
Total	3,111	0.31	3,637	0.38	1.17	1.23

Notes: May not sum or multiply precisely due to rounding.

*Although the correct per-measure savings value was applied, a calculation error resulted in the quantity of faucet aerators installed to be divided by 12

Net Impacts

The program net savings are identical to gross savings of 3,637 MWH and 0.38 MW, as shown in Table 49. The Evaluation Team applied a NTGR of 1.0, which is a common assumption when evaluating low-income programs as most customers are highly unlikely to install these measures or take additional action without the program due to income constraints.

Table 49. Net Impacts for NEEP

Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
MWH	MW	MWH	MW	MWH	MW
3,637	0.38	1.00	1.00	3,637	0.38

3.6 Appliance Recycling Program

3.6.1 Program Description

The Appliance Recycling Program (ARP) offers incentives to SCE&G residential customers who recycle less-efficient, but operable, primary and secondary refrigerators and/or stand-alone freezers. In addition to the incentive, recycled appliances are picked up free of charge. The program generates energy savings by removing the less-efficient measures from the market so that they would not continue to operate inefficiently within SCE&G's service territory. The program is implemented with assistance from ARCA, Inc. and offered to active residential electric customers seeking to recycle operational appliances between 10 and 30 cubic feet. Customers receive a \$50 rebate per appliance and are limited to two rebates per program year.

3.6.2 Program Performance Summary

The program reported a total of 3,347 recycled appliances⁷ for 3,114 participants, slightly exceeding its participation forecast. The program greatly exceeded its forecasted energy and demand savings, not only due to higher-than-expected participation, but also because ex-post saving per participant exceeded forecasts. The program's actual versus forecasted results are shown in Table 50.

Table 50. Appliance Recycling Program Forecasts and Results

Metric	Forecast	Actual	% of Forecast
Cost	\$598,181	\$708,869	119%
Participants (customers)	2,997	3,114	104%
Gross MWH Savings	2,286	3,218	141%
Gross MW Savings	0.28	0.37	129%
Net MWH Savings	N/A	2,011	N/A
Net MW Savings	N/A	0.24	N/A

Table 51 summarizes the number of unique participants and the number of recycled appliances in PY7. The majority (93%) of participants recycled one appliance.

⁷ 2,710 refrigerators and 637 freezers.

Table 51. Total Recycled Appliances and Unique Participants by Appliance Type

Number and Type of Appliance	Total PY7 Measures	Number of Unique Participants	% of Total
1 Refrigerator	2,390	2,390	77%
1 Freezer	492	492	16%
1 Refrigerator & 1 freezer	240	120	4%
2 Refrigerators	200	100	3%
2 Freezers	24	12	0.4%
Total	3,346	3,114	100.00%

3.6.3 Impact and Data-Tracking Findings

The Evaluation Team performed a thorough review of the program-tracking database and identified one record that misrepresented the quantity of recycled freezers.⁸ As a result, the Evaluation Team adjusted the ex-ante freezer quantity by one. Each record in the program-tracking database was unique; there were no duplicate records and thus no further adjustments were needed. To arrive at the total ex-post measure quantity, the Evaluation Team applied a 100% verification rate established through the PY5 evaluation to the revised measure quantity, which resulted in no changes. Table 52 compares the ex-ante, revised and ex-post measure counts for the program.

Table 52. Appliance Recycling Verified Volume

Measure Type	Ex-Ante Measure Quantity	Revised Measure Quantity	Verification Rate	Ex-Post Measure Quantity
Refrigerator	2,710	2,710	100%	2,710
Freezer	637	636	100%	636
Total	3,347	3,346	100%	3,346

To evaluate gross savings, the Evaluation Team conducted an engineering review of the ex-ante per unit savings assumptions for recycled refrigerators and freezers. To calculate ex-ante savings, SCE&G applied the ex-post deemed savings values for refrigerators and freezers from the PY6 evaluation results. However, the Evaluation Team applied a different savings methodology for PY7 freezer estimates than PY6. The Uniform Methods Projects (UMP) protocols that were available during the PY6 evaluation did not include savings methodologies for recycled freezers. The Evaluation Team relied on the ENERGY STAR® Retirement Savings Calculator⁹ to derive PY6 freezer impacts. Since then, the UMP issued a revised version¹⁰ that includes recycled freezer savings methods, which the Evaluation Team adopted in PY7. Appendix E provides detailed methods and results from the engineering analysis.

As shown in Table 53, the PY7 Appliance Recycling Program achieved 3,218 MWH and 0.37 MW in ex-post gross savings. Ex-post gross impacts were lower than ex-ante gross impacts, with overall gross realization rates of 0.90 and 0.91 for energy and demand savings, respectively. Differences in ex-ante and ex-post gross savings are due to a number of reasons, however the main difference is due to a change in savings calculation

⁸ This one record indicated that both 1 refrigerator and 1 freezer were recycled. However, only 1 refrigerator was recycled.

⁹ ENERGY STAR® Retirement Savings Calculator: <http://www.ENERGYSTAR.gov/index.cfm?fuseaction=refrig.calculator>

¹⁰ The Uniform Methods Project (UMP): Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 7: Refrigerator Recycling Evaluation Protocol. September 2017. <https://www.nrel.gov/docs/fy17osti/68563.pdf>

Program-Specific Findings

methodology for freezer savings to align with the UMP. The next largest contributors were differences from PY6 in terms of average appliance size and age, which slightly reduced overall savings.

Table 53. Appliance Recycling Program Ex-Post Gross Savings Summary

Measure Type	Ex-Post Quantity	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
		MWH	MW	MWH	MW	MWH	MW
Refrigerators	2,710	2,921	0.33	2,785	0.32	0.95	0.98
Freezers	636	647	0.08	432	0.05	0.67	0.65
Total	3,346	3,569	0.40	3,218	0.37	0.90	0.91

The Evaluation Team applied self-reported NTGRs from PY5 evaluation results to the PY7 ex-post gross savings values to determine ex-post net savings. As shown in Table 87, the program ultimately achieved net savings of 2,011 MWH and 0.24 MW.

Table 54. Appliance Recycling Program Ex-Post Net Savings Summary

Measure Type	Ex-Post Gross Savings		NTGR		Ex-Post Net Savings	
	MWH	MW	MWH	MW	MWH	MW
Refrigerators	2,785	0.32	0.61	0.64	1,703	0.20
Freezers	432	0.05	0.71	0.74	308	0.04
Total	3,218	0.37	0.62	0.65	2,011	0.24

3.7 EnergyWise for Your Business Program

3.7.1 Program Description

The EnergyWise for Your Business (EWfYB) Program offers incentives to businesses to encourage installation of high-efficiency equipment and building improvements that reduce energy costs. ICF assists SCE&G with the implementation of EWfYB. The program is available to eligible commercial and industrial (C&I) customers in the SCE&G electric service area. At the close of PY7, 418 large commercial and industrial accounts, representing approximately 25% of SCE&G's retail electric load, had opted out of SCE&G's DSM programs. The program includes both prescriptive and custom incentives. The Evaluation Team combined these two components in this report for simplicity and because they are implemented as one program.

3.7.2 Program Performance

Table 55 shows the program's PY7 performance in comparison to the forecast. The program generally achieved the same level of MWH savings per-project as forecasted, but higher participation led to the program exceeding its energy savings goals. This additional participation also helped the program ultimately meet its demand goals, though the program saved fewer MWs per project than forecasted primarily due to ex-post adjustments made to waste heat and coincidence factors for prescriptive lighting projects.

Program-Specific Findings

Table 55. Program Performance Compared to Forecast

Metric	Forecast	Actual	% of Forecast
Program Cost	\$4,495,000	\$4,755,438	106%
Participation (Projects)	650	756	116%
Gross MWH Savings	31,633	38,287	121%
Gross MW Savings	5.84	5.88	101%
Net MWH Savings	N/A	27,567	N/A
Net MW Savings	N/A	4.41	N/A

As with previous years, lighting measures continue to drive program savings.

Table 56. Savings by Project Type

Project Type	Number of Projects	Percent of MWH	Percent of MW
Prescriptive Lighting	628	71%	72%
Custom Incentives	28	20%	18%
Prescriptive New Construction Lighting	15	3%	4%
Prescriptive Unitary HVAC	31	3%	3%
Prescriptive Food Service	41	2%	1%
Prescriptive Chillers	5	1%	2%
Prescriptive Variable-Frequency Drive (VFD)	8	0%	1%
Total	756	100%	100%

3.7.3 Impact and Data Tracking Findings

The Evaluation Team calculated ex-ante energy savings by reviewing the reported savings against the program-tracking database and summing the tracked savings for each completed project. The impact evaluation included multiple steps to calculate ex-post savings. The first step checked the accuracy of the program database; and the next steps accounted for the accuracy and reasonableness of the engineering estimates used to calculate the savings. The ex-post net analysis accounts for program free-ridership and spillover. Detailed results of the analysis at the individual project level are contained in Appendix F.

Database Review

Our database review found no discrepancies. As seen from Table 57, we found that the program database accurately reflected the application of savings.

Program-Specific Findings

Table 57. Database Review Adjustments

Application Type	Ex-Ante Gross		Revised Gross		Tracking Accuracy	
	MWH	MW	MWH	MW	MWH	MW
Prescriptive Lighting	27,223	5.37	27,223	5.37	100%	100%
Custom Incentives	7,541	1.37	7,541	1.37	100%	100%
Prescriptive New Construction Lighting	1,271	0.27	1,271	0.27	100%	100%
Prescriptive Unitary HVAC	1,130	0.21	1,130	0.21	100%	100%
Prescriptive Food Service	681	0.07	681	0.07	100%	100%
Prescriptive Chillers	447	0.12	447	0.12	100%	100%
Prescriptive Variable-Frequency Drive (VFD)	180	0.04	180	0.04	100%	100%
Total	38,474	7.46	38,474	7.46	100%	100%

Note: Due to rounding, percentages may not add up to 100%.

Project Desk Reviews

The team evaluated savings for PY7 by conducting engineering desk reviews on a stratified random sample of projects from the Prescriptive Lighting and Custom programs, and a simple random sample of projects from the New Construction Lighting and Prescriptive Non-Lighting Programs. The realization rates for each stratum were then weighted by savings to determine the program-level realization rate. Table 58 provides a comparison of ex-ante gross and ex-post gross savings. Notably, the Prescriptive Non-Lighting category is a combination of all prescriptive food service, HVAC chillers, HVAC VFD and unitary HVAC measures. Realization rates were primarily driven by differences between ex-ante savings application methods and the recommended methods in SCE&G's Commercial Energy Algorithm Manual (CEAM)¹¹ for prescriptive lighting and HVAC measures. Notably, SCE&G stopped accepting applications that are not aligned with the CEAM in PY7. However, given the that projects tend to take six months to a year to complete, there were still many non-CEAM-aligned projects begun in PY6 that completed in PY7. More detail by measure type is provided after the table.

Table 58. Ex-Ante and Ex-Post Program Savings

Application Type	Ex-Ante		Ex-Post		Gross Realization Rate	
	MWH	MW	MWH	MW	MWH	MW
Prescriptive Lighting	27,223	5.37	27,600	3.83	101%	71%
Custom Incentives	7,541	1.37	7,544	1.23	100%	90%
Prescriptive Non-Lighting	2,438	0.45	1,873	0.45	77%	100%
New Construction Lighting	1,271	0.27	1,270	0.37	100%	135%
Total	38,474	7.462	38,287	5.88	100%	79%

Note: Due to rounding percentages may not add up to 100%.

Prescriptive Lighting and New Construction Lighting Projects

The 15 projects selected for the Prescriptive Lighting sample included a mix of LED and fluorescent upgrades and some lighting control projects. Similarly, the New Construction Lighting sample of five projects included a

¹¹ The Evaluation Team developed the South Carolina Electric & Gas Commercial Energy Algorithm Manual (CEAM) to document all evaluated savings calculations and assumptions. After a review and comparison of several TRMs, the Evaluation Team chose to reference the Texas TRM for lighting coincidence factors in the CEAM. Texas TRM reference: Public Utility Commission of Texas. Texas Technical Reference Manual Version 2.0, Volume 3: Nonresidential Measures. April 18, 2014.

Program-Specific Findings

mix of LED and lighting controls. To determine ex-post gross savings, the Evaluation Team adjusted several parameters within the lighting calculations, including:

- **Coincidence factors:** Ex-ante calculations adjusted the coincidence factor based on the timing of CEAM changes applied to application through the program year, moving from a generalized coincidence factor of 0.747 to a coincidence factor that aligns with the CEAM based on building type. In instances where a generalized coincidence factor was used, the Evaluation Team adjusted the coincidence factor to align with the building type (e.g., office, warehouse, exterior) based on the CEAM. This resulted in either increasing or decreasing the assumed factor, depending on the specific project. For exterior LED lighting projects, the team applied a coincidence factor of 0.28 to all lighting that did not operate 24/7, based on PY4 evaluation efforts. For spaces that operate 24/7, the team applied a coincidence factor of 1.0 as the lights operate for the duration of the peak period. The team adjusted the coincidence factors in 4 of 15 (26%) prescriptive lighting sampled projects where this occurred.
- **Building Type:** Discrepancies between ex-ante and ex-post building type identification were observed in approximately 25% of desk reviews. Ex-ante building types were assigned at the project level and distributed throughout the individual measures. Misclassification of building types has a compounding effect on energy savings deriving from the coincidence factor and waste heat factor, which are dependent on building type. For example, some exterior lighting measures were improperly specified as interior lighting measures using project-level information, resulting in the application of waste heat factors for exterior lighting. The Evaluation Team adjusted building types on a measure-by-measure basis leading to an average decrease of 49% in demand savings for sampled projects.

Prescriptive Non-Lighting Projects

The ten projects selected for the Prescriptive Non-Lighting sample included a mix of HVAC, refrigerator, variable frequency drive (VFD), ice machines and ovens. The Evaluation Team's methods and assumptions are discussed below, organized by type of measure.

HVAC projects accounted for half of the sampled projects and more than 70% of the ex-ante KWH savings within the sample. For PY7, ex-ante HVAC calculations adopted the methods outlined in the CEAM of using project-specific parameters such as unit efficiency and capacity to evaluate savings. The Evaluation Team found that ex-ante calculations applied Seasonal Energy Efficiency Ratios (SEER) to savings calculations for unitary systems equal to or greater than 65 kBTU/hr in capacity, in contrast to CEAM guidance for the use of Energy Efficiency Ratios (EER) for unitary systems in this capacity range. Further, ex-ante baseline efficiencies for the units being replaced did not align with CEAM specified minimum baseline efficiencies, which were used in ex-post calculations. These differences resulted in ex-post savings being 52% of ex-ante KWH savings and 88% of ex-ante KW savings for HVAC projects.

Variable frequency drives (VFDs) account for one of the ten sampled projects with ex-post savings equal to 100% of ex-ante KWH savings and 101% of ex-ante KW savings. The slight difference in ex-ante KW savings is due to rounding.

The remaining four sampled projects, from the food service and high efficiency equipment measure group, included two projects (88 installs) of electronically commutated motor (ECM) upgrades for refrigeration units and two projects (10 installs) of refrigeration unit replacement, including combination oven and batch ice maker measures. Ex-ante savings relied on deemed savings from a mix of sources including the South Carolina Measure Database and ENERGY STAR®, while the ex-post savings employed CEAM methods. For the ECM refrigerator/freezer projects, ex-post savings were significantly higher than ex-ante, approximately 200%, while the remaining measures typically resulted in lower ex-post savings than ex-ante. Overall, the food service and high efficiency equipment measure group had a realization rate of 135% for both KWH and KW savings.

Program-Specific Findings

Custom Projects

A total of ten projects were sampled from the population of Custom projects, with the sample consisting of six lighting projects and a single project each of chiller, building envelope improvement, HVAC system improvement and new construction.

To verify lighting savings, the Evaluation Team reviewed all project documentation to verify the baseline and efficient lighting fixture type, quantity and wattage and made changes as necessary. The Evaluation Team made coincidence factor and applied waste heat factor adjustments similar to Prescriptive Lighting projects.

The remaining projects, including the new construction, building envelope, chiller and HVAC project, relied on energy models from the project vendor. The Evaluation Team closely reviewed all project documentation for these projects, including the model inputs and results. The Evaluation Team did perform secondary calculations, including using CEAM methods, comparing the claimed savings per-ton with similar projects from PY5 and PY6, and performing billing analysis using actual facility-specific monthly consumption data. This multi-point validation approach allowed for replacement of one validation approach with another when necessary, such as billing information was not robust enough to allow for analysis. This comparison ensured none of the per-project claimed savings totals were drastically out of line with what is expected for these types of projects. The result of the Evaluation Team's analysis led to the assignment of a 100% realization rate for the projects, because ex-ante claimed savings were within the ex-post's evaluated range of expected savings.

Net Verified Savings

Table 59 shows the ex-post net savings that the program achieved in PY7. The NTGR used here is the value used in PY7 program planning and has been used in the evaluation since PY3.

Table 59. Ex-Post Net Results

Savings	Ex-Post Gross Savings	NTGR	Ex-Post Net Savings
MWH	38,287	0.72	27,567
MW	5.88	0.75	4.41

3.8 Small Business Energy Solutions (SBES)

3.8.1 Program Description

The Small Business Energy Solutions (SBES) Program is a small business offering that was first launched to non-residential customers in November of 2014 but enrolled its first participants mid-way through PY5. The program originated to serve a market that was underserved in the Energy Wise for Your Business Program. SBES participation is restricted to small businesses or nonprofits who have five or fewer SCE&G electric accounts and annual energy usage of no more than 350,000 KWH.

The program offers a no-cost on-site energy audit and equipment rebates for lighting and refrigeration. While the SBES Program offers fewer measures than EWfYB, the financial incentives offered are higher to help overcome cost barriers often faced by small businesses. SBES covers up to 80% of pre-tax project costs of energy efficient technologies pursued through the program, not to exceed \$6,000 per utility account per program year.

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ICF administers the program and sub-contracts to Facility Solutions Group (FSG) for lighting measures and National Resource Management (NRM) for refrigeration measures. FSG and NRM use local contractors to perform installations.

3.8.2 Program Performance Summary

Table 60 shows the PY7 program performed well versus forecasts despite falling short of spending and participation goals. Evaluation results found more savings per project than forecasted assumptions.

Table 60. Small Business Energy Solutions Program Forecasts and Results

Metric	Forecast	Actual	% of Forecast Accomplished
Cost	\$2,575,216	\$2,398,219	93%
Participation (Projects)	635	598	94%
Gross MWH Savings	5,232	6,766	129%
Gross MW Savings	1.77	1.88	106%
Net MWH Savings	N/A	6, 512	N/A
Net MW Savings	N/A	1.85	N/A

The highest contributors to savings for lighting measures, accounting for 89% and 93% of KWH and KW savings, respectively include: industrial processing, retail, offices, religious facilities and warehouses. The highest contributors to savings for refrigeration measures include retail and restaurant establishments. The majority (87%) of energy savings come from lighting projects and refrigeration measures account for the remaining (13%) of energy savings. Table 61 lists each segment with associated participation levels and savings.

Table 61. Small Business Energy Solutions Participation and Savings by Segment

Segment	Projects	Ex-Ante Savings		% Ex-Ante Savings	
		KWH	KW	KWH	KW
Lighting	598	5,913,143	1,833.62	87%	97%
Industrial Processing	158	1,967,308	517.57	33%	28%
Retail	151	1,117,869	397.47	19%	22%
Office	109	1,051,249	377.52	18%	21%
Religious Facility	54	580,344	242.17	10%	13%
Warehouse	62	566,774	165.28	10%	9%
Restaurant	21	151,556	30.38	3%	2%
School	9	149,682	36.67	3%	2%
Health Facility	12	123,056	40.03	2%	2%
Grocery	12	109,965	10.06	2%	1%
Other	9	92,343	14.94	2%	1%
Lodging	1	2,998	1.52	0%	0%
Refrigeration	59	891,548	60.52	13%	3%
Retail	52	845,602	58.08	95%	96%
Restaurant	7	45,946	2.45	5%	4%
Grand Total	598*	6,804,691	1,894.14	100%	100%

*Numbers do not total to 598 projects because some projects included both refrigeration and lighting measures

3.8.3 Impact and Data-Tracking Findings

The impact evaluation included several high-level steps to calculate ex-post savings. The first step checked the accuracy of the program database followed by an ex-ante per-measure review. The ex-post verification and ex-post net analyses account for installation verification, free-ridership and spillover based on PY5 evaluation results.

Database Validation

The Evaluation Team first reviewed the tracking database to check for multiplication errors or other discrepancies. The team multiplied per-unit savings estimates in the database by the quantities in the database to ensure total energy and demand savings were calculated correctly throughout the database. The Evaluation Team also checked the per-unit savings across the different measures to ensure no obvious tracking errors occurred in the database. As part of this review, we identified 35 projects with positive energy savings, but zero demand savings. Through discussions with SCE&G, we confirmed these projects were all exterior lighting used during off-peak summer hours, resulting in zero demand savings. An additional 11 projects were identified as having higher or lower than average energy or demand savings per unit installed, which were attributed to an error during data collection while in the field. SCE&G provided a revised database that corrected the 11 erroneous records (i.e., Revised Ex-Ante in Table 62).

Ex-Ante Per-Measure Review

The Evaluation Team reviewed the per-measure savings across the different measures to confirm that ex-ante savings are within expected ranges for each measure type. For similar measures, we compared the PY7 per-measure savings to those found in the PY6 database. We perform this review because the program does not

Program-Specific Findings

apply a deemed savings value, but rather calculates energy savings based on custom inputs (i.e. actual reported hours of use, installed lighting wattages, etc.). Also, the tracking database provided to the Evaluation Team did not provide the custom inputs or original applications, leaving us unable to repeat the ex-ante calculations using only the tracking database.

Table 62 includes the ex-ante and revised ex-ante savings resulting from our database validation and per-measure review. The slight difference between ex-ante and revised ex-ante is a result of the database error described above for the 11 records.

Table 62. Small Business Energy Solutions Gross Savings

Measure Type	Database Quantity	Ex-Ante KWH	Ex-Ante KW	Revised Ex-Ante KWH	Revised Ex-Ante KW
Fluorescent	19,184	4,629,005	1,605.23	4,626,409	1,603.88
LED Exterior Lights	978	725,552	31.29	725,552	31.29
Other controls & EC Motors	499	333,021	29.76	333,021	29.76
Evaporative/Compressor Controls	59	331,507	11.34	331,507	11.34
LED Screw-ins	3,844	308,363	145.72	297,979	141.76
Cooler Door Heater Controls	30	226,483	19.37	226,483	19.37
LED Case Lights	190	127,584	15.88	127,584	15.88
Abandoned Fluorescent	197	84,344	29.50	84,344	29.50
LED Exit Sign	179	25,193	2.40	26,498	2.48
Abandoned HID	11	11,631	3.60	11,631	3.60
Occupancy Sensor	7	1,471	-	1,471	-
Freezer door heater controls	1	537	0.05	537	0.05
Grand Total	25,179	6,804,691	1,894.14	6,793,018	1,888.92

The Evaluation Team then applied verification rates based on PY5 evaluation results. These values are presented in Table 63 and result in realization rates just under 100%.

Table 63. Small Business Energy Solutions Ex-Ante and Ex-Post Gross Savings

Savings Type	Ex-Ante Gross	Revised Ex-Ante	Verification Rate from PY5	Ex-Post Gross	Realization Rate
MWH	6,805	6,793	0.99	6,766	0.99
MW	1.894	1.889	0.99	1.881	0.99

As shown in Table 64, the program achieved ex-post net savings of 6,495 MWH and 1.84 MW. To arrive at ex-post net savings, the Evaluation Team applied PY5-evaluated NTGRs to ex-post gross savings.

Table 64. Small Business Energy Solutions Ex-Post Net Results

Savings	Ex-Post Gross Savings	NTGR	Ex-Post Net Savings
MWH	6,766	0.96	6,495
MW	1.881	0.98	1.84

Appendix A. ENERGY STAR® Lighting Detailed Methods

Gross Impacts Detailed Methods

This section details engineering algorithms and assumptions used to estimate energy and demand savings from the program lighting products, as well as algorithms used to estimate in-service rate (ISR) for each program.

Engineering Algorithms and Assumptions

Lighting product offerings differed between the three distinct lighting programs. The Business Office Lighting program participants received a free kit with five standard LED bulbs: three 10W; one 12W; one 14W. SCE&G customers purchasing products through the Online Store could choose between a variety of standard, reflector and specialty lighting products (including globe, three-way and decorative products) available in various wattages and pack sizes. Both LED and CFL products were available on the Online Store for the first two months of PY7 before CFLs were phased out of the program. Recipients of the newly introduced Low-Income LED Kits received five standard 9W LED bulbs each.

Despite the differences in offerings, the Evaluation Team used a similar approach to calculating energy and demand savings across the three programs.

Equation 1 and Equation 2 provide the formulas used to calculate revised energy and demand savings.

Equation 1. Lighting Program Revised Gross Energy Savings Formula

$$KWh\ Savings = (HOU \times 365) \times (W_{Baseline} - W_{Eff}) \times WHFe / 1000$$

Equation 2. Lighting Program Revised Gross Demand Savings Formula

$$KW\ Savings = (W_{Baseline} - W_{Eff}) \times WHFd \times CF / 1000$$

Where:

KWh Savings = first-year energy savings

KW Savings = first-year peak demand savings

HOU = Average number of hours a day the light is in use

W_{Baseline} = Baseline wattage

W_{Eff} = Wattage of the energy efficient replacement

WHFe = Waste heat factor for energy use, accounts for the effects of more efficient lighting on cooling energy use

WHFd = Waste heat factor for demand, accounts for the effects of more efficient lighting on cooling energy demand

CF = Coincidence factor

Equation 3 and Equation 4 provide the formulas used to calculate ex-post gross and ex-post net savings.

Equation 3. Lighting Program Ex-Post Gross Savings Formula

$$Ex\text{-}Post\ Gross = Revised\ Gross \times First\text{-}Year\ ISR$$

Equation 4. Lighting Program Ex-Post Net Savings Formula

$$Ex\text{-}Post\ Net = Ex\text{-}Post\ Gross \times NTGR$$

The following sections detail the sources of each savings assumption.

ENERGY STAR® Lighting Detailed Methods

Hours of Use (HOU)

The Evaluation Team used a daily hours of use (HOU) estimate of 3.0 hours per day to calculate energy savings for program measures. An SCE&G-specific HOU estimate is unavailable and is likely to be very similar to other jurisdictions. As such, the Evaluation Team completed a secondary review of past research studies across a range of jurisdictions and developed a reasonable HOU estimate based on the average of these studies. The results of the secondary research and the recommended HOU estimate are provided in Table 65.

Table 65. Comparative Summary of Lighting Hours of Use

Source	Daily Hours of Use (hrs/day)
Ohio TRM (Sept 2009)	3.63
New York State EEPs (Oct 2010)	3.20
ENERGYSTAR.gov Calculator (Apr 2009)	3.00
Mid-Atlantic TRM v. 2.0 (July 2011)	2.98
Ohio TRM (August 2010)	2.85
Massachusetts TRM (Oct 2010)	2.80
ComEd (2011)	2.74
Maine (Feb 2007)	2.70
Connecticut (Sept 2007)	2.60
South Carolina (2012)	2.44
Recommended	3.00

Incandescent Equivalent Baseline Wattage

Traditionally, the baseline wattage for energy efficient products has been an incandescent light bulb. However, the provisions of the 2007 EISA rulings have slowly increased the efficiency requirements of general service incandescent light bulbs. The regulations were gradually phased in, affecting 100-watt general service incandescents in January 2012, 75-watt incandescents in January 2013 and 60-watt and 40-watt incandescents in January 2014. Manufacturers responded to EISA by developing a halogen bulb that meets the new requirements. These new “EISA-compliant” halogens ultimately replaced incandescents as the baseline for calculating program savings. Manufacturers and retailers were allowed to sell through their existing inventory of incandescents, but by 2017, three years after the last phase took effect, affected incandescents are assumed to be virtually non-existent on store shelves.

As part of the engineering desk review, the Evaluation Team cross-referenced product descriptions with assigned wattages, baseline wattages and lumen ranges. Final baseline wattages were assigned for each product based on verified lumen counts.

ENERGY STAR® Lighting Detailed Methods

Table 66 provides the post-EISA 2007 baseline wattage by lumen range for standard products.

Table 66. Baseline Wattages for Standard Bulbs

Lumen Range	Incandescent Equivalent Wattage	Post-EISA Baseline Wattage
250–309	<40	25
310–749	40	29
750–1,049	60	43
1,050–1,489	75	53
1,490–2,600	100	72
2,601–2,999	150	150
3,000–5,279	200	200
5,280–6,209	300	300

In addition to general service products, energy efficiency standards for certain reflector and flood light products were affected by Department of Energy (DOE) regulations.¹² These regulations went into effect at the beginning of 2012 and affected major reflector lamp types including PAR20, PAR30, PAR38, BR30, ER30, BR40 R20 or ER40. The legislation affected lamps with the following criteria:

- Lamps with wattages between 40 watts to 205 watts
- Lamps with diameter larger than 2.5 inches
- Lamps with operating voltage of 120V (standard) or 130V (long-life bulbs)
- Lamps with standard or modified color output

The legislation requires that the above-mentioned products meet halogen efficiency levels. Notable exceptions to the legislation include:

- Lamps rated at 50 watts or less that are ER30, BR30, BR40, or RE40.
- Lamps rated at 65 watts that are BR30, BR40 or ER40
- R20 incandescent reflector lamps rated 45 watts or less

¹² Department of Energy. 10 CFR 430 Energy Conservation Program: Energy Conservation Standards and Test Procedures for General Service Fluorescent Lamps and Incandescent Reflector Lamps: Final Rule. July 2009.

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The Evaluation Team completed research and analysis to develop adjusted wattages for reflector products affected by the DOE legislation.

Table 67. Baseline Wattages for DOE Reflector and Flood Light Products

Reflector Bulb Type	Lumen Range	Reflector Bulb Baseline Wattage
R, PAR, ER, BR, BPAR, or similar bulb shapes with medium screw bases and diameter >2.5"	600-849	50
	850-999	55
	1,000-1,300	65
ER30, BR30, BR40, ER40	400-449	40
	450-499	45
	500-1,419	65
R40	400-449	40
	450-719	45
All reflector lamps below the lumen ranges specified above	200-299	30
	300-399	40

Program products exempt from both EISA and DOE legislation were assigned an incandescent baseline wattage based on verified lumen counts.

Efficient Product Wattage

The Evaluation Team used actual wattages of the efficient products as specified on the product packaging by product manufacturers.

Waste Heat Factors

The inclusion of waste heat factors for lighting is based on the concept that heating loads increase to supplement the reduction in heat that was once provided by incandescent lamps and cooling loads decrease since there is less heat output from the incandescent lamp that was once in place. The overall effects are complicated to determine, as they are influenced not just by the type of lighting used, but also by the climate and the type of HVAC systems used to heat and cool the home. Waste heat factors developed for one climate region cannot be used in another, since the climate and the mix of heating and cooling use vary across the country. SCE&G currently does not have waste heat factor estimates that are specific to its territory and fuel mix. The Evaluation Team therefore used an energy and demand waste heat factor of 1.0.

Coincidence Factor

The Evaluation Team used a coincidence factor (CF) of 0.10 to calculate demand savings during the peak summer period. SCE&G-specific CF estimate is unavailable. As such, the Evaluation Team completed a secondary review of past research studies across a range of jurisdictions and developed a reasonable CF estimate, which represents the average across all studies. The results of the secondary research and the recommended CF estimate are provided in Table 68.

Table 68. Comparative Summary of Coincidence Factors

Source	Coincidence Factor
Ohio TRM (Sept 2009)	0.15
Massachusetts TRM (Oct 2010)	0.11
Mid-Atlantic TRM v. 2.0 (July 2011)	0.11
Ohio TRM (August 2010)	0.11
South Carolina (2012)	0.10
Maine (Feb 2007)	0.10
Connecticut (Sept 2007)	0.08
New York State EEPs (Oct 2010)	0.08
Recommended	0.10

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Table 69 contains tracked and verified bulbs and savings by product.

Table 69. Summary of Gross Tracked and Revised Energy (KWH) and Demand (KW) Deemed Savings by Program and Bulb Type

Program Component	Bulb Type	Verified Units Sold	Ex-Ante Tracked Savings		Gross Revised Savings		Percentage Difference	
			KWH	KW	KWH	KW	KWH	KW
Online Store	CFL - 30W 3-Way	65	4,982	0.46	4,982	0.46	100%	100%
Online Store	CFL - 18W Standard	13	529	0.05	498	0.05	94%	88%
Online Store	LED - 18W 3-Way	693	30,353	2.77	31,871	2.91	105%	105%
Online Store	LED - 20W 3-Way	1,106	48,443	4.42	48,443	4.42	100%	100%
Online Store	LED - 3.5W Decorative	640	21,024	1.92	15,067	1.38	72%	72%
Online Store	LED - 4W Decorative	236	9,303	0.94	9,303	0.85	100%	90%
Online Store	LED - 4.5W Decorative	9,470	361,447	36.77	364,304	33.27	101%	90%
Online Store	LED - 5W Decorative	2,866	104,342	10.55	98,830	9.03	95%	86%
Online Store	LED - 7W Decorative	559	21,426	2.24	22,036	2.01	103%	90%
Online Store	LED - 10W Downlight	19	1,092	0.10	1,040	0.10	95%	100%
Online Store	LED - 11W Downlight	55	3,162	0.28	4,457	0.41	141%	148%
Online Store	LED - 14W Downlight	107	6,151	0.54	5,390	0.49	88%	92%
Online Store	LED - 7W Linear	4	182	0.02	110	0.01	60%	63%
Online Store	LED - 8.5W Linear	34	1,545	0.14	316	0.03	20%	21%
Online Store	LED - 10W Linear	261	5,716	0.52	6,287	0.57	110%	110%
Online Store	LED - 12W Linear	18	818	0.07	394	0.04	48%	50%
Online Store	LED - 5W PAR38	748	28,671	2.99	28,667	2.62	100%	87%
Online Store	LED - 7W PAR38	309	11,844	1.24	11,166	1.02	94%	82%
Online Store	LED - 7.5W PAR38	174	10,003	0.87	10,003	0.91	100%	105%
Online Store	LED - 10W PAR38	328	14,904	1.31	17,958	1.64	120%	125%
Online Store	LED - 17W PAR38	297	15,287	1.49	15,610	1.43	102%	96%
Online Store	LED - 18W PAR38	2	103	0.01	103	0.01	100%	94%
Online Store	LED - 6W Reflector	49	1,529	0.15	2,361	0.22	154%	147%
Online Store	LED - 7W Reflector	321	14,763	1.28	11,599	1.06	79%	83%
Online Store	LED - 8W Reflector	1	46	0.00	46	0.00	100%	105%
Online Store	LED - 9W Reflector	221	13,430	1.33	13,552	1.24	101%	93%
Online Store	LED - 9.5W Reflector	1,037	63,018	6.22	63,021	5.76	100%	93%
Online Store	LED - 10W Reflector	14,845	894,114	89.07	894,040	81.65	100%	92%
Online Store	LED - 12W Reflector	1,491	68,571	5.96	86,530	7.90	126%	133%
Online Store	LED - 6W Standard	2,067	74,629	7.62	52,057	4.75	70%	62%
Online Store	LED - 7W Standard	289	9,020	0.87	6,962	0.64	77%	73%
Online Store	LED - 7.5W Standard	181	7,035	0.72	7,036	0.64	100%	89%
Online Store	LED - 9W Standard	118,273	5,374,325	473.09	4,403,304	402.13	82%	85%
Online Store	LED - 9.5W Standard	715	32,490	2.86	26,228	2.40	81%	84%
Online Store	LED - 10W Standard	18,893	858,498	75.57	682,699	62.35	80%	82%
Online Store	LED - 14W Standard	337	13,837	1.35	14,392	1.31	104%	98%

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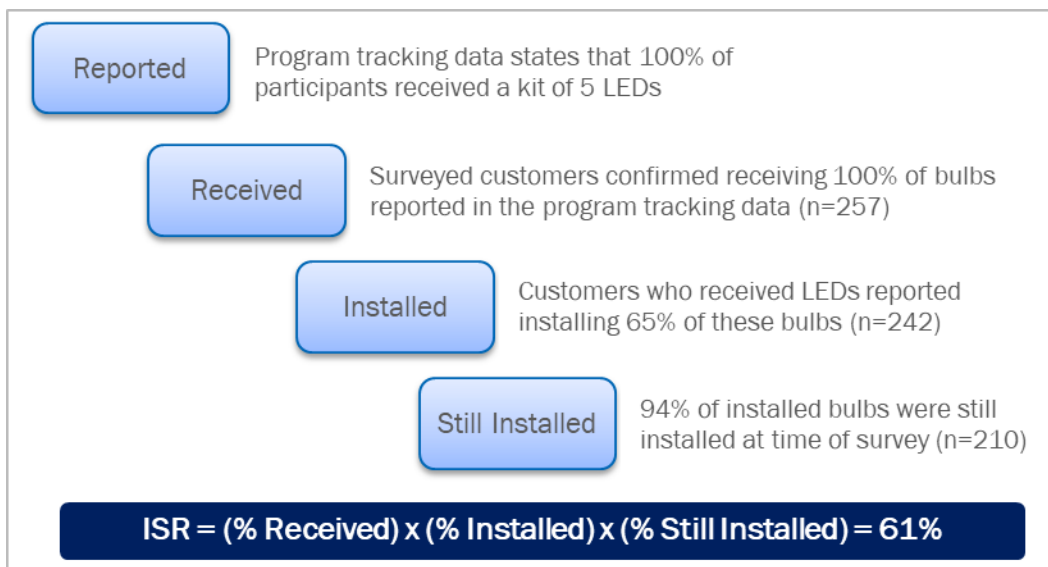
Program Component	Bulb Type	Verified Units Sold	Ex-Ante Tracked Savings		Gross Revised Savings		Percentage Difference	
			KWH	KW	KWH	KW	KWH	KW
Online Store	LED - 18W Standard	1,130	46,007	4.52	66,817	6.10	145%	135%
BOL	LED - 10W Standard	20,583	935,343	85.42	743,767	67.92	80%	80%
BOL	LED - 12W Standard	6,861	304,259	27.90	308,025	28.13	101%	101%
BOL	LED - 14W Standard	6,861	313,393	28.77	435,742	39.79	139%	138%
Low-Income LED Kits	LED - 9W Standard	4,280	194,483	17.12	159,344	14.55	82%	85%
Total		216,439	9,920,119	899.51	8,674,357	792.18	87%	88%

In-Service Rate

The program's tracked savings assumed an ISR of 100% for all three lighting programs. Customers, however, do not always install all of the bulbs that they receive or purchase right away, but rather place bulbs in storage for future use. For the BOL and Online Store programs, the Evaluation Team applied ISRs based on participant surveys conducted as part of the PY6 evaluation.

For the new Low-Income LED Mail Kits, the Evaluation Team developed an ISR estimate of 61% based on results of a survey of PY7 recipients. As part of the survey effort, participants were asked to verify the number of bulbs received and to report how many of the received bulbs they installed and how many of the installed bulbs were still installed at the time of the survey. As such, the ISR incorporated the receipt, installation and persistence of program products. All respondents confirmed that they received five bulbs. We interviewed 257 participants, and 242 were able to provide usable information about their installation of the bulbs. These 242 respondents reported installing 65% of the bulbs they received. Most of these bulbs were still installed at the time of the survey (94%) for an overall installation rate of 61%. Figure 1 outlines the development of the ISR estimate for the LED Mail Kit component.

Figure 1. Residential Lighting ISR Components



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Table 70 below summarizes the ISRs applied for each program.

Table 70. Residential Lighting ISR Results by Program

Program	n	ISR	Relative Precision (90% Confidence)	Confidence Interval
Business Office Lighting	100	67%	7%	6%
Online Store	288	64%	6%	5%
Low-Income LED Kits	240	61%	6%	6%

Carryover Savings Estimation

Though customers put some bulbs purchased in storage for later use, research in other jurisdictions shows that 98% of all bulbs purchased are installed within 3 years.¹³ The program-specific ISRs capture the first-year installation of program bulbs, and an installation trajectory is employed to estimate later installation of program bulbs that were initially placed in storage.

For PY5, the Evaluation Team used an ISR of 70% for the BOL program and 67% for the Online Store program, meaning that another 28% of PY5 BOL bulbs and 31% of PY5 Online Store bulbs would be placed in storage and installed in the subsequent two years. For PY6, the Evaluation Team used an ISR of 67% for the BOL Program and 64% for the Online Store. Therefore, 31% of bulbs received through the PY6 BOL program and 34% of bulbs received through the PY6 Online Store would be stored and installed over the following two years. The Evaluation Team further assumed that of the bulbs placed in storage during year 1, 55% would be installed in year two and 45% would be installed in year three. Table 71 below provides the detailed trajectory.

Table 71. Lighting Program Carryover Savings Trajectories from Prior Years

Year Purchased	Carryover Savings Rate by Year Accrued			
	PY5	PY6	PY7	PY8
PY5 BOL	70%	28% x 55% = 15.4%	28% x 45% = 12.6%	N/A
PY5 Online Store	67%	31% x 55% = 17.1%	31% x 45% = 14.0%	N/A
PY6 BOL	N/A	67%	31% x 55% = 17.1%	31% x 45% = 14.0%
PY6 Online Store	N/A	64%	34% x 55% = 18.7%	34% x 45% = 15.3%

The Evaluation Team estimated the carryover savings attributable to PY7 by multiplying verified gross and net savings from PY5 and PY6 by the PY7 carryover rates above. For PY5, BOL and Online Store savings were multiplied by 12.6% and 14.0%, respectively, to estimate PY5 savings claimable in PY7. For PY6, BOL and Online Store savings were multiplied by 17.1% and 18.7%, respectively, to estimate PY6 carryover savings claimable in PY7.

Moving forward, the Evaluation Team will be shifting to an updated trajectory for carryover savings consistent with the latest update to the UMP. First-year ex-post savings will continue to be based on program-specific ISRs, but for bulbs distributed in PY7 or later, we will assume that 24% of any bulbs not installed in the first year will be installed in the following year. In each subsequent year, we will assume an additional 24% of remaining uninstalled will be installed the following year, resulting in diminishing marginal installations and claimable savings in each consecutive year after distribution. For the sake of continuity, bulbs distributed in PY6 will still use their originally assigned installation trajectory as outlined in the previous table, meaning 14%

¹³ KEMA, Inc. The Cadmus Group, Inc. Itron, Inc., PA Consulting Group, Jai J. Mitchell Analytics, *Final Evaluation Report: Upstream Lighting Program*. Prepared for the California Public Utilities Commission, Energy Division. February 8, 2010

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of PY6 BOL savings and 15.3% of PY6 Online Store savings will be claimed in PY8. Table 72 below outlines this approach for claiming carryover savings from PY6 and PY7 in PY8 and subsequent program years.

Table 72. Lighting Program Carryover Savings Trajectories for Future Years

Year Purchased	Carryover Savings Rate by Year Accrued			
	PY7	PY8	PY9	PY10
PY6 BOL	31% x 55% = 17.1%	31% x 45% = 14.0%	N/A	N/A
PY6 Online Store	34% x 55% = 18.7%	34% x 45% = 15.3%	N/A	N/A
PY7 BOL	67%	33% x 24% = 8%	25% x 24% = 6%	19% x 24% = 5%
PY7 Online Store	64%	36% x 24% = 9%	27% x 24% = 6%	21% x 24% = 5%
PY7 Online Store	61%	39% x 24% = 9%	30% x 24% = 7%	21% x 24% = 5%

Net-to-Gross Methods and Results

This section details the methodology the Evaluation Team used to calculate NTGRs for each program. The NTGR represents the portion of the energy and demand savings associated with a program-supported measure or behavior change that would not have been realized in the absence of the program. In other words, the NTGR ratio represents the share of program induced savings. The NTGR ratio consists of free-ridership (FR) and spillover(SO). FR is the proportion of the program-achieved verified gross savings that would have been realized absent the program. SO occurs when participants take additional energy-saving actions that are influenced by program interventions but did not receive program support.

For the Online Store and Business Office Lighting programs, the Evaluation Team relied on FR and SO estimated as part of the PY6 evaluation. To estimate FR and participant SO for the new Free LED program, the Evaluation Team conducted a participant survey with recipients of Low-Income LED Kits.

The final NTGR for each program was calculated using the equation provided below.

Equation 5. NTGR Formula

$$NTGR = (1 - FR) + SO$$

Table 73 provides a summary of FR, SO and final NTGRs for each program. As can be seen in the table, the final NTGR is 0.83 for the Business Office program and 0.73 for the Online Store program, in line with the values applied in PY6.

Table 73. Final NTGR Summary

Estimate	Business Office	Online Store	Low-Income LED Kits*
FR	0.22	0.29	0.14
SO	0	0.02	0.03
NTGR	0.83	0.73	0.95

*The Low-Income LED Kits NTGR reflects a weighted average of the low-income deemed NTGR of 1.0 (57% of participants) and research-based NTGR of 0.89 (remaining 43% of participants).

Low-Income LED Kits Free-Ridership Methodology

The Evaluation Team relied on a telephone survey census attempt of program participants to develop estimates of FR. To assess FR, interviewers first asked participants about the role price plays in their lighting

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purchase decisions. Those participants who reported that they generally purchase the lowest priced product were deemed non-free riders. With halogen products still being the lowest priced items on the store shelves, the Evaluation Team assumed that these customers would have likely purchased less efficient light bulbs in the absence of the program.

Interviewers asked the remaining participants what they would have purchased the next time they needed light bulbs if they had not received their free LEDs. Participants who said they would have purchased incandescents, halogens, or the lowest cost light bulb option were classified as non-free riders. Participants who said they would have purchased CFLs or LEDs received follow-up questions about the quantity of energy efficient bulbs they would have purchased. As part of these question, interviewers cited typical retail LED prices and CFL prices, respectively, to ensure participant awareness of the higher cost of the energy-efficient products, and before asking participants to confirm their answer. Participants who reported purchasing a mix of products in the absence of the program received follow-up questions exploring the mix and validating respondent choices of the products in the mix.

Finally, as part of the FR algorithm, the Evaluation Team explored participant installation patterns of program LEDs and gave the program additional credit in cases where it motivated customers to replace *working* less efficient products instead of waiting for those bulbs to burn out. By encouraging participants to replace working light bulbs, the program accelerates the occurrence of energy savings and therefore deserves a credit. In cases where participants said that in the absence of the program they would have waited for their bulbs to burn out, the Evaluation Team gave the program the credit of either 0.5 or 0.25 depending on the number of *working* light bulbs that program LEDs replaced.

As part of the response validation process, the Evaluation Team compared participant free-ridership responses to their self-reported awareness of the CFL and LEDs. In cases where participants reported being unaware of one or both technologies, the Evaluation Team overrode participant free-ridership responses to 0 (no free ridership) for the respective technology. Figure 2 below presents the detailed algorithm.

Table 74 presents FR results for the Low-Income LED Mailed Kits program. The overall FR rate is 0.14 for non-low-income participants.

Table 74. Low-Income LED Mailed Kits FR Results

Metric	Result
FR	14.1%
Relative precision (at 90% confidence)	5.1%
Confidence interval	0.09
n	91

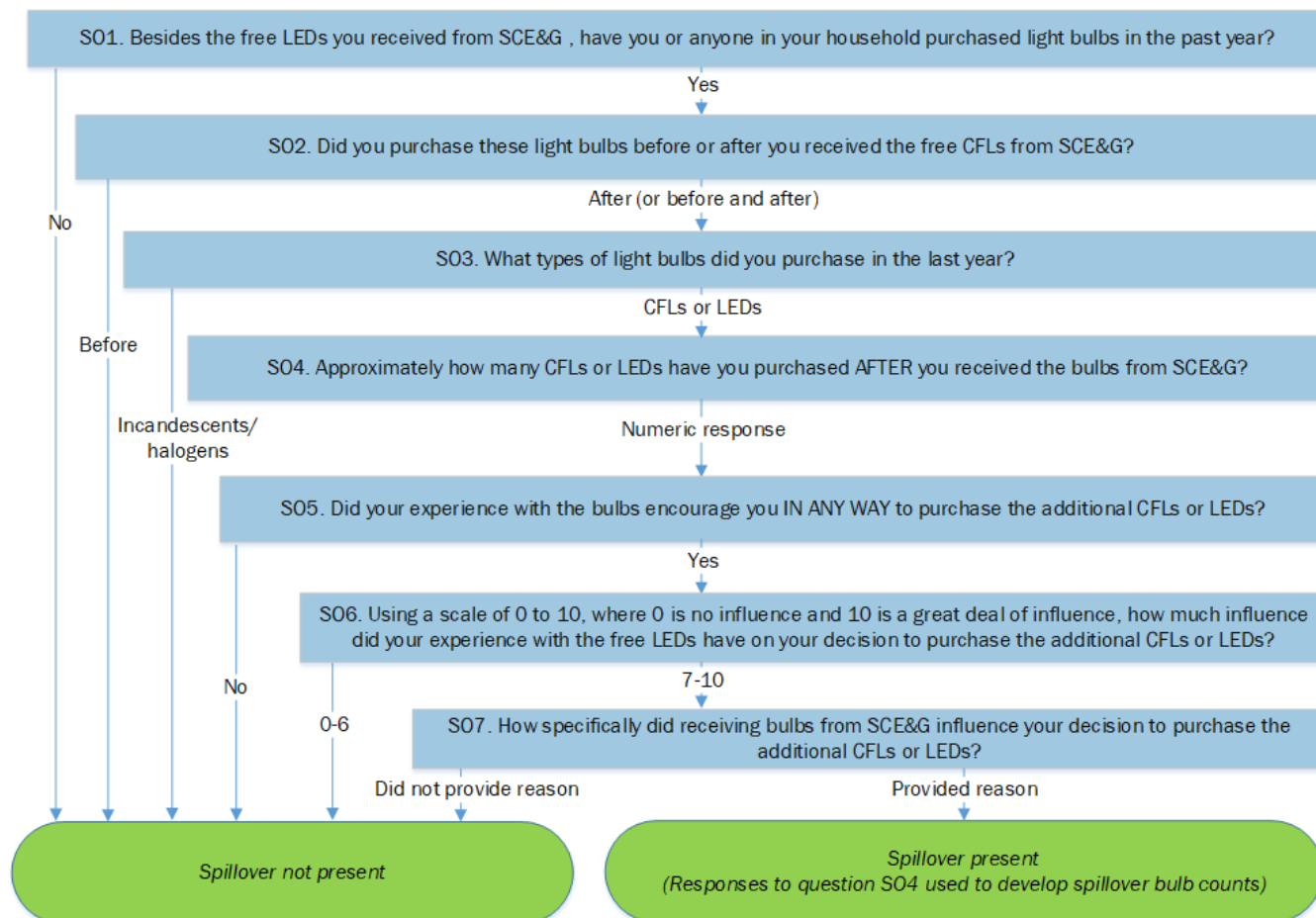
Low-Income LED Mailed Kits Spillover Methodology

The Evaluation Team estimated participant spillover for the Low-Income LED Kits program based on a telephone survey census attempt of program participants. Exploration of the presence of spillover effects from other end uses, as well as their magnitude, would have resulted in a much lengthier survey. Given the nature of the programs, the Evaluation Team does not expect that spillover effects on other end uses would be detectable or substantive.

The survey asked respondents about non-program CFL and LED purchases and about the degree to which the program influenced those purchases decisions. Respondents were first asked whether they purchased any CFLs or LEDs since receiving the free program LEDs. Those who had were then further probed about the total number of bulbs purchased. To minimize survey length, the Evaluation Team did not ask questions about bulb type (standard, specialty, etc.). Respondents who reported purchasing additional energy efficient lighting products were asked follow-up questions about the degree to which they felt the program influenced their purchase, both in the form of a quantitative rating and qualitative explanation. For participants who gave a high rating and provided valid explanation of that rating, spillover bulbs were calculated as the number of energy efficient bulbs purchased since participating in the program multiplied by the given rating out of 10 (e.g. 5 bulbs purchased since participating and an influence rating of 8/10 would be represented as $5 \times 0.8 = 4$ spillover bulbs). The total number of spillover bulbs was then divided by the total number of program bulbs received by respondents with valid responses to spillover questions to estimate a participant spillover rate of 3% for the Low-Income LED Kit program. Low-income respondents were omitted from this analysis as they were assigned a deemed NTGR of 1.0.

The Evaluation Team estimated a program spillover rate as outlined in the following equation and table.

Figure 3. Low-Income LED Kits Participant Spillover Algorithm



Equation 6. Spillover Rate Formula

$$\text{Spillover Rate} = \frac{\text{Spillover Bulbs}}{\text{Bulbs Received by Valid Spillover Respondents}}$$

Table 75. Free LED Kit Spillover Rate Estimate

Metric	Result
Spillover bulbs	19
Bulbs received by valid spillover respondents	565
Spillover rate	3%
Relative precision (at 90% confidence)	2%
Confidence interval	0.05
n	113

Appendix B. Heating and Cooling Program Deemed Savings Values

This appendix summarizes the deemed savings values for each Heating and Cooling Program measure for the Heating & Cooling Equipment and Ductwork program components. Details regarding engineering algorithms and assumptions used to estimate each deemed energy and demand savings value are provided in the SCE&G PY6 Heating & Cooling Program Guidance Report. These values were applied in PY7 to establish program ex-ante and ex-post savings.

Heating & Cooling Equipment Program

The Evaluation Team developed per-ton deemed savings values as part of the PY6 evaluation to apply in PY7. Deemed savings values for measures new to PY7 were calculated by applying the same methodology as described in the PY6 Evaluation Report. Table 76 compares the ex-ante and ex-post deemed savings values for each PY7 Heating & Cooling Equipment measure, as well as identifies measures new to PY7.

Table 76. Ex-Ante and Ex-Post Savings Per Ton Comparison (Heating & Cooling Equipment)

Measure	Ex-Ante		Ex-Post	
	KWH/Ton	KW/Ton	KWH/Ton	KW/Ton
Central Air Conditioner (Central AC)				
SF - Packaged - Furnace/AC - SEER 15	99.64	0.080	99.64	0.083
SF - Split - Furnace/AC - SEER 15	110.96	0.090	110.96	0.094
SF - Packaged - Furnace/AC - SEER 16	148.81	0.120	148.81	0.124
SF - Split - Furnace/AC - SEER 16	160.93	0.140	160.93	0.135
SF - Split - Furnace/AC - SEER 17	188.72	0.160	188.72	0.156
SF - Split - Furnace/AC - SEER 18	201.45	0.160	201.45	0.162
SF - Split - Furnace/AC - SEER 19	230.41	0.180	230.41	0.183
SF - Split - Furnace/AC - SEER 20	296.59	0.237	296.59	0.237
SF - Split - Furnace/AC - SEER 21*	296.59	0.240	295.49	0.230
Air Source Heat Pumps (ASHP)				
MH - Split - ASHP - SEER 15*	200.70	0.170	509.48	0.435
SF - Split - ASHP - SEER 15	283.93	0.240	283.93	0.240
MH - Packaged - ASHP - SEER 15	191.86	0.150	191.86	0.147
SF - Packaged - ASHP - SEER 15	299.94	0.260	299.94	0.256
SF - Split - ASHP - SEER 16	382.12	0.280	382.12	0.275
SF - Packaged - ASHP - SEER 16	382.51	0.280	382.51	0.276
SF - Split - ASHP - SEER 17	464.24	0.360	464.24	0.361
SF - Split - ASHP - SEER 18	506.73	0.410	506.73	0.414
SF - Split - ASHP - SEER 19	543.93	0.460	543.93	0.457
SF - Split - ASHP - SEER 20	518.05	0.450	518.05	0.451
SF - Split - ASHP - SEER 21	713.64	0.600	713.64	0.598
SF - Split - ASHP - SEER 22	689.96	0.590	689.96	0.586
SF - Split - ASHP - SEER 23	669.16	0.570	669.16	0.572
SF - Split - ASHP - SEER 25*	836.80	0.460	689.80	0.579
SF - Split - ASHP - SEER 30*	964.02	0.520	1,402.88	0.591

Heating and Cooling Program Deemed Savings Values

Measure	Ex-Ante		Ex-Post	
	KWH/Ton	KW/Ton	KWH/Ton	KW/Ton
SF - Split - ASHP - SEER 38*	964.02	0.520	1,599.10	0.337
Dual Fuel Heat Pumps (DFHP)				
SF - Split - DFHP - SEER 15	191.86	0.150	191.86	0.147
SF - Split - DFHP - SEER 16	430.90	0.310	430.90	0.310
SF - Packaged - DFHP - SEER 16*	270.30	0.230	269.66	0.195

*Ex-ante differs from ex-post for measures new to PY7. The Evaluation Team calculated a deemed savings value as part of the PY7 evaluation for these measures.

Ductwork

Table 77 compares the ex-ante and ex-post deemed savings values for each PY7 Ductwork measure. The ex-ante and ex-post deemed values for ductwork measures are identical.

Table 77. Ex-Ante and Ex-Post Savings Per-Ton Comparison (Ductwork)

Measure	Ex-Ante		Ex-Post	
	KWH/Ton	KW/Ton	KWH/Ton	KW/Ton
Complete Duct Replacement (Heat Pump)	612.00	0.159	612.00	0.159
Complete Duct Replacement (AC)	342.00	0.159	342.00	0.159
Duct Sealing (Heat Pump)	362.45	0.103	362.45	0.103
Duct Sealing (AC)	221.90	0.103	221.90	0.103
Duct Insulation (Heat Pump)	249.60	0.056	249.60	0.056
Duct Insulation (AC)	120.10	0.056	120.10	0.056

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Leave-Behind Measure Deemed Savings Values

The per household deemed savings values for participants incorporate savings from all install measures, except faucet aerators, as well as recommended measure savings. Table 78 provides more detail on the per household values for customers who received kits with 4 CFLs & 1 LED. Table 79 provides details for customers who received kits with 5 LEDs.

Table 78. Per Household Deemed Savings Value Details (Kit with 4 CFLs & 1 LED)

Measure	Unit	Ex-Ante Measure Quantity	PY6 Installation Rate**	Ex-Post Measure Quantity	Savings per Unit		Ex-Post Gross Savings	
					KWH	KW	KWH	KW
Kit of 4 CFL, 1 LED*	1 Kit	1,426	70%	998	200.39	0.02	200,024	18.27
100-Watt Incandescent Equivalent CFL	1 Bulb	N/A*	N/A*	N/A*	53.66	0.005	N/A*	N/A*
75-Watt Incandescent Equivalent CFL	2 Bulb				76.65	0.007		
60-Watt Incandescent Equivalent CFL	1 Bulb				32.85	0.003		
60-Watt Incandescent Equivalent LED	1 Bulb				37.23	0.003		
Pipe Insulation - 6 ft.	1 6 ft. Wrap	223	69%	154	82.30	0.01	12,664	1.45
WH Tank Wrap	1 Blanket	253	69%	175	360.80	0.04	62,985	7.16
Installed Measures Total							275,673	26.87
Recommended Measures	Per participant	1,426	N/A	1,426	572.48	0.109	816,354	155.65
Overall Kit Total							1,092,027	182.52
Total Number of Unique Participants in PY7							1,426	
Average Deemed PY7 per household savings							765.80	0.13

*Installation rates applied at the kit-level to calculate ex-post gross savings for lighting measures

** The Evaluation team used the CFL and LED ISRs obtained from the PY6 participant survey to calculate weighted ISRs for the lighting kits based on the number of lamps and lamp type within each kit

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Table 79. Per Household Deemed Savings Value Details (Kit with 5 LEDs)

Measure	Unit	Ex-Ante Measure Quantity	PY6 Installation Rate**	Ex-Post Measure Quantity	Savings per Unit		Ex-Post Gross Savings	
					KWH	KW	KWH	KW
Kit of 5 LEDs*	1 Kit	1,389	79%	1,097	216.81	0.020	237,908	21.73
10W A19 LED (800 Lumens)	3 Bulb	N/A*	N/A*	N/A*	108.41	0.010	N/A*	N/A*
12W A19 LED (1100 Lumens)	1 Bulb				44.90	0.004		
14W A19 LED (1500 Lumens)	1 Bulb				63.51	0.006		
Pipe Insulation - 6 ft.	1 6 ft. Wrap	210	69%	145	82.30	0.01	11,926	1.36
WH Tank Wrap	1 Blanket	262	69%	181	360.80	0.04	65,225	7.41
Installed Measures							315,059	30.50
Recommended Measures***	Per participant	1,385	N/A	1,385	572.48	0.109	792,882	151.18
Overall Program							1,107,941	181.68
Total Number of Unique Participants in PY7							1,389	
Average Deemed PY7 per Household savings							797.65	0.13

*Installation rates applied at the kit-level to calculate ex-post gross savings for lighting measures

** The Evaluation team used LED ISRs obtained from the PY6 participant survey to calculate installation rates for the LED lighting kits

*** This total excludes the four participants who already received recommended measures at the time of their initial home energy check with the 4 CFLs and 1 LED kit

Carryover Savings Calculation

The Evaluation Team calculated carryover CFL and LED savings for bulbs placed in storage in PY5 and PY6, with expected installation in PY7. The 2014 UMP¹⁴ indicates that most bulbs placed in storage (up to 97%) become installed within four years of purchase (including the initial program year) and recommends calculating the installation rate when stored bulbs are installed as follows:

Installation Rates for Bulbs in Storage

$$ISR_{Year\ 1} = ISR_{Surveyed}$$

$$ISR_{Year\ 2} = (Storage\ \%_{Year\ 1} * 41\%) + ISR_{Surveyed}$$

$$ISR_{Year\ 3} = (Storage\ \%_{Year\ 1} * 69\%) + ISR_{Surveyed}$$

$$ISR_{Year\ 4} = 97\% - ISR_{Year\ 3}$$

Where:

$ISR_{Surveyed}$	=	Installation rate from self-reported survey results for the year the measure was distributed (initial program year)
$ISR_{Year\ 2}$	=	Percentage of stored bulbs installed in Year 2 (one year after program participation)
$ISR_{Year\ 3}$	=	Percentage of stored bulbs installed in Year 3 (two years after program participation)
$ISR_{Year\ 4}$	=	Percentage of stored bulbs installed in Year 4 (three years after program participation)
$Storage\ \%_{Year\ 1}$	=	Percentage of bulbs placed in storage for the year the measure was distributed
41%	=	Total percentage of bulbs installed (of original bulbs placed in storage) within two years, including the program year
69%	=	Total percentage of bulbs installed (of original bulbs placed in storage) within three years, including the program year
97%	=	Total assumed percentage of bulbs installed (of original bulbs placed in storage) within four years, including the program year

Participants placed in storage approximately 28% of PY5 CFLs, 33% of PY6 CFLs and 21% of PY6 LEDs received through the program. The 2014 UMP assumes that 41% of all bulbs placed in storage are installed in the next year, 28% of the remaining stored bulbs are installed the following year and up to 97% of all stored bulbs will be installed by the end of the fourth year (including initial program year in which bulbs were distributed).

Table 80 summarizes the percent of stored bulbs expected to be installed in the three years following the initial program year.

¹⁴ Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 21: Residential Lighting Evaluation Protocol. Section 4.12 In-Service Rate. December 2014.

Table 80. Percentage of Stored Bulbs Installed by Year

Distribution Year	Bulb Type	% Stored Bulbs Installed in PY6	% Stored Bulbs Installed in PY7	% Stored Bulbs Installed in PY8	% Stored Bulbs Installed in PY9
PY5	CFL	41%	28%	6%	N/A
PY6	CFL	N/A	41%	28%	7%
PY6	LED	N/A	41%	28%	4%

To calculate the carryover CFL and LED savings, the Evaluation Team used self-reported installation rates and applied the equations above to estimate the number of stored CFLs and LEDs distributed in PY5 and PY6 but installed in PY7. Table 8 summarizes the number of stored CFLs and LEDs installed in PY7. The evaluation includes savings for a total of 2,646 CFLs and 159 LEDs.

Table 8. Quantity of CFLs and LEDs Installed in PY7

Distribution Year	Measure	% Stored Bulbs Installed in PY7	Total Volume in Storage*	Volume Installed in PY7
PY5	13W CFL	28%	3,790	1,061
PY6	13W CFL	41%	3,865	1,584
PY6	9W LED	41%	388	159
Total			8,043	2,805

*Total volume in storage as of first year of distribution

Table 81 summarizes the additional carryover gross savings from the stored CFL and LED measures installed in PY7, applying recommended deemed savings values for the year in which the bulbs were installed (PY7).

Table 81. Carryover Gross Savings (Savings Added to PY7)

Distribution Year	Measure	Volume Installed in PY7	Ex-Post per-bulb Savings		Total Gross Carryover Savings	
			KWH	KW	KWH	KW
PY5	13W CFL	1,061	32.85	0.003	34,859	3.18
PY6	13W CFL	1,584	32.85	0.003	52,051	4.75
PY6	9W LED	152	37.23	0.003	5,927	0.54
Total		2,805	N/A	N/A	92,836	8.48

Table 82 summarizes the additional carryover net savings from the CFL and LED measures installed in PY7, applying the same NTGRs from the initial distribution year.

Table 82. Carryover Net Savings (Savings Added to PY7)

Distribution Year	Measure	Total Volume Installed in PY7	Total Gross Carryover Savings		NTG		Total Net Carryover KWH Savings	
			KWH	KW	KWH	KW	KWH	KW
PY5	13W CFL	1,061	34,859	3.18	0.68	0.78	23,704	2.48
PY6	13W CFL	1,584	52,051	4.75	0.79	0.74	41,120	3.52
PY6	9W LED	159	5,927	0.54	0.79	0.74	4,682	0.40
Total		2,805	92,836	8.48	N/A	N/A	69,506	6.40

Appendix D. NEEP Detailed Mobile Home Savings Calculation Methods

Savings Methodology

The Evaluation Team applied the following steps to determine the total ex-post gross and average mobile home savings for the NEEP program:

Step 1: Calculated Deemed Per-Measure Savings Values: The Evaluation Team calculated per-measure savings values by applying HVAC weights using a combination of the PY7 program tracking data and the 2009 Residential Energy Consumption Survey (RECS) data for South Carolina. The percentage of mobile home participants with cooling and electric heating come directly from the PY7 program tracking data. However, the database does not differentiate between heat pumps and electric resistance heating for those with electric heating, therefore the Evaluation Team leveraged RECS data to parse the two heating equipment types. Table 83 outlines the applied HVAC weights and Table 84

Table 83. HVAC Weights

HVAC Type	HVAC Weight	Source/Notes
Cooling Present*	96%	PY7 NEEP Mobile Home Program tracking database**
Electric Heating	83%	PY7 NEEP Mobile Home Program tracking database***
Heat Pump	35%	Applied RECS 2009 data assumption that 43% of the 83% of participants with electric heating have heat pumps
Electric Resistance Heating*	38%	Applied RECS 2009 data assumption that 46% of the 83% of participants with electric heating have electric resistance heating

* Includes cooling for participants with either central air conditioners or heat pumps

**Participants receiving duct sealing measures were confirmed with having central cooling, with the exception of two participants.

*** Utility Group E or EU provided in the PY7 NEEP program tracking database represent participants with electric heating.

Table 84 Per-Measure Savings Values (with Applied HVAC Weights)

Measure	Units	KWH/Unit	KW/Unit
Air Sealing > 30% Leakage Reduction	Per participant	285.74	0.0744
Air Sealing > 40% Leakage Reduction	Per participant	380.98	0.0992
Attic Plug & Fill Insulation (R-30)	Per square feet	1.59	0.0004
Belly Board Insulation (R-19)	Per square feet	1.49	0.0004
Belly Board Repair	Per square feet	1.49	0.0004
Digital Switch Plate Wall Thermometer	Per thermometer	17.71	-
Duct Sealing > 10% Reduction	Per participant	591.96	0.2182
Programmable Communicating Thermostat	Per thermostat	644.68	-
Reflective Roof Coating	Per square feet	1.15	0.0002
CO Monitor*	Per Monitor	N/A	N/A

*Measure does not yield savings, distributed through the program to ensure safety.

Step 2: Calculated an Average Per-Mobile Home Savings Value: The Evaluation Team calculated an average per-mobile home savings value by multiplying the per-measure savings values from Table 84 by

their respective measure quantities provided in the PY7 database and dividing by the total number of participating mobile homes (n=80). Table 85 summarizes these steps and shows the resulting average ex-post per-mobile home savings values of 1,705 KWH and 0.470 KW.

Step 3: Calculated Total Ex-post Gross Savings: The Evaluation Team multiplied the average per-mobile home savings values of 1,705 KWH and 0.470 KW by the number of participating mobile homes (n=80) to determine the total PY7 ex-post gross savings. The mobile home component of the NEEP program achieved total ex-post gross savings of 136 MWH and 0.038 MW, with realization rates of 124% and 121% for energy and demand, respectively (Table 85).

Savings Summary

Table 85 summarizes total the average per-mobile home savings and total ex-post gross savings for NEEP Mobile Home measures.

Table 85. PY7 Ex-Post Mobile Home Savings Summary

Measure	Total Measures Installed in PY7 [A]	Units	Ex-Post per Measure		Total Ex-Post Savings	
			KWH [B]	KW [C]	KWH [A*B]	KW [A*C]
Air Sealing > 30% Leakage Reduction	46	Participants	285.74	0.0744	13,144	3.42
Air Sealing > 40% Leakage Reduction	34	Participants	380.98	0.0992	12,953	3.37
Attic Plug & Fill Insulation (R-30)	29,922	Square Feet	1.59	0.0004	47,705	12.13
Belly Board Repair	795	Square Feet	1.49	0.0004	1,187	0.30
Digital Switch Plate Wall Thermometer	80	Thermometers	17.71	-	1,417	0.00
Duct Sealing > 10% Reduction	79	Participants	591.96	0.2182	46,765	17.24
Programmable Communicating Thermostat	8	Thermostats	644.68	-	5,157	0.00
Reflective Roof Coating	7,004	Square Feet	1.15	0.0002	8,055	1.16
CO Monitor	2	Monitors	N/A	N/A	N/A	N/A
Total			N/A	N/A	136,382	37.63
Average Savings per Mobile Home*					1,705	0.47

*The Average Savings per Mobile Home = Total Ex-Post Savings / Number of Participating Mobile Homes (n=80)

Differences in Ex-Ante and Ex-Post Per-Mobile Home Savings

The ex-post per-mobile home savings values for energy and demand are 24% and 21% larger, respectively, than the ex-ante per-mobile home savings values. Ex-ante applied the PY6 ex-post per-mobile home savings values to calculate the total PY7 ex-ante mobile home savings. However, we found that the PY6 and PY7 ex-post per-home savings vary due to the following reasons:

- **Differences in Installed Measure Quantity and Program Participation:** Both the PY6 and PY7 ex-post per-home savings values were calculated based on the unique blend of measures, installed measure quantities and participation in each respective program year. We found that, on average, the total number of installed measure quantities in PY7 increased by 51% compared to measure quantities in

PY6 (see Table 86). Since participation increased by 60%¹⁵ and installed measure quantities increased by 51%, we expected a higher per-home savings value in PY7 compared to the ex-post per-home value calculated in PY6. Had participation increased by the same percentage as installed measures, we would expect similar ex-post per-home savings values to those calculated in PY6.

Table 86. PY6 and PY7 Installed Quantity Comparison (by Measure Type)

Measure Description	Units	Installed Measure Quantity		Δ Qty	% Difference
		PY6	PY7		
Digital Switch Plate Wall Thermometer	Thermometers	50	80	+ 30	60% Increase
Air Sealing > 30% Leakage Reduction	Participants	27	46	+ 19	70% Increase
Air Sealing > 40% Leakage Reduction	Participants	18	34	+ 16	89% Increase
Duct Sealing with > 10% Reduction	Participants	41	79	+ 38	93% Increase
Attic Plug & Fill Insulation (R-30)	Square Feet	22,541	29,922	+ 7,381	33% Increase
Belly Board Repair	Square Feet	407	795	+ 388	95% Increase
Belly Board Insulation (R-19)	Square Feet	1,000	0	- 1,000	100% Decrease
Programmable Communicating Thermostat	Thermostats	3	8	+ 5	167% Increase
Reflective Roof Coating	Square Feet	1,092	7,004	+ 5,912	541% Increase
CO Monitor	Monitors	0	2	+ 2	N/A
Total		25,179	37,970	+ 12,791	51% Increase

- **Differences in Assumed Heating Fuel and Equipment Types:** The ex-post per-home savings value developed in PY6 relied on RECS 2009 census data to determine the percentage of homes with electric heating and whether cooling is present.¹⁶ In PY7, the Evaluation Team leveraged data from the PY7 database to determine the percentage of participants with electric heating and whether cooling is present. The RECs assumptions applied in PY6 differ from that observed in the PY7 program tracking database. Namely, 96% of PY7 NEEP mobile home participants have cooling and 83% have electric heating. These percentages are larger than those applied in PY6 using RECS census data assumptions of 83% for cooling present and 65% for electric heating. As a result of the higher percentage of participants with electric heating and cooling in PY7, ex-post savings estimates increased.

¹⁵ PY6 included 50 mobile homes; PY7 included 80 mobile homes.

¹⁶ The PY6 NEEP database did not provide this information.

Appendix E. Appliance Recycling Program Detailed Methods

From an evaluation perspective, appliance recycling programs differ from most demand-side management (DSM) programs in that savings are generated by incentivizing the removal of an operable but inefficient measure, rather than rebating the installation of an efficient one. This poses unique evaluation challenges that require less-traditional methodological approaches. The methodology used in this evaluation represents the accepted industry standard for evaluating appliance recycling programs and thus provides SCE&G with a reliable estimate of the program's energy savings.

The Evaluation Team established ex-post gross and net savings by applying the following evaluation steps:

- **Step 1: Perform a program-tracking database review.** Reviewed contents of the program-tracking database to identify the quantity and type of recycled appliances.
- **Step 2: Verify appliance volume by applying verification rates.** Applied a 100% verification rate established through PY5 evaluation results where a representative sample of participants confirmed that 100% of the appliances were indeed recycled through the program.
- **Step 3: Review program-tracking database for appliance characteristics.** Reviewed appliance characteristic data, including age, size, appliance type (i.e. side-by-side, top freezer, chest, etc.), location and usage type (primary or secondary). Where data were missing (mainly for location information), the Evaluation Team applied probable values based on assumptions from other available information.¹⁷
- **Step 4: Apply ex-post per-measure savings algorithms.** Applied algorithms from the most recent version of the UMP¹⁸ to arrive at the average ex-post per-measure savings for recycled refrigerators and freezers.
- **Step 5: Apply a part-use factor (PUF).** Applied a PUF (established through PY5 evaluation results) that adjusts ex-post per-measure savings based on the number of months the recycled appliance was operating in the past 12 months prior to being recycled.
- **Step 6: Calculate total ex-post gross energy and demand savings per appliance type.** Summarized total reported ex-ante and ex-post energy and demand savings and calculated a program realization rate.
- **Step 7: Apply NTGRs.** Applied NTGRs from PY5 evaluation results to establish ex-post net energy and demand savings.

¹⁷ The PY7 database did not capture the location of the appliance when it was operating. As a result, we applied location data from PY5. This methodology is consistent with the previous program evaluation, as location data was also missing in PY6.

¹⁸ The Uniform Methods Project (UMP): Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 7: Refrigerator Recycling Evaluation Protocol. September 2017. <https://www.nrel.gov/docs/fy17osti/68563.pdf>

Step 1: Perform a Program-Tracking Database Desk Review

The Evaluation Team identified one record that incorrectly included an additional freezer. As a result, the Evaluation Team adjusted the ex-ante freezer quantity by one (see Table 87).

Table 87. Comparison of Ex-Ante and Revised Measure Quantities

Measure Type	Ex-Ante Measure Quantity	Difference	Revised Measure Quantity
Refrigerator	2,710	0	2,710
Freezer	637	-1	636
Total	3,347	-1	3,346

Step 2: Verify Appliance Volume by Applying Verification Rates

The program-tracking database included 3,114 unique participants who recycled 3,346 appliances: 2,710 refrigerators (81% of total) and 636 freezers (19% of total). The Evaluation Team applied a 100% verification rate established through the PY5 evaluation results to determine the verified measure quantity.

Table 88. Appliance Recycling Verified Volume

Measure Type	Revised Measure Quantity	Verification Rate	Ex-Post Measure Quantity
Refrigerator	2,710	100%	2,710
Freezer	636	100%	636
Total	3,346	100%	3,346

Table 89 summarizes the number of unique participants and the number of recycled appliances in PY7. The majority (93%) of participants recycled one appliance and approximately 7% recycled two appliances.

Table 89. Total Recycled Appliances and Unique Participants by Appliance Type

Number and Type of Appliance	Total PY7 Measures	Number of Unique Participants	% of Participant Total
1 Refrigerator	2,390	2,390	76.75%
1 Freezer	492	492	15.80%
1 Refrigerator & 1 freezer	240	120	3.85%
2 Refrigerators	200	100	3.21%
2 Freezers	24	12	0.39%
Total	3,346	3,114	100.00%

Step 3: Review Program-Tracking Database for Appliance Characteristics

The Evaluation Team reviewed the program-tracking database to determine whether the listed appliance characteristics were within a reasonable range and met program requirements. This step is important because energy-savings algorithms are dependent on specific appliance characteristics, including age, size, appliance type, location and usage type (primary or secondary). The Evaluation Team reviewed the following appliance characteristics:

Size Requirements

The Evaluation Team reviewed program-tracking data to ensure that all appliances met program size requirements (between 10 and 30 cubic feet). The Evaluation Team did not adjust records for sizing as all recycled appliances met program guidelines (see Table 90).

Table 90. Refrigerator and Freezer Capacity (Cubic Feet) Breakdown

Refrigerator			Freezer		
Cu. Ft.	%	N	Cu. Ft.	%	N
< 10	0.0%	0	< 10	0.0%	0
10 to 30	100.0%	2,710	10 to 30	100.0%	636
Total		2,710	Total		636

Appliance Age

Assessing the age of the recycled appliance is important because of the progressive increase in appliance efficiency due primarily to federal standards, where older appliances result in more energy savings for the program than newer appliances.

The tracking database revealed that the majority of appliances were more than 15 years old.¹⁹ The Evaluation Team capped the age at 50 years to any records older than 50.²⁰ Table 91 shows the distribution of appliance vintages collected in PY7.

Table 91. Refrigerator and Freezer Vintage Distribution

Refrigerator			Freezer		
Age (years)	%	N	Age (years)	%	N
< 5	1.77%	48	< 5	0.94%	6
5 to 9	7.68%	208	5 to 9	5.66%	36
10 to 14	31.14%	844	10 to 14	27.67%	176
15 to 19	20.92%	567	15 to 19	14.78%	94
20 to 29	26.68%	723	20 to 29	27.20%	173
30 to 39	10.74%	291	30 to 39	19.65%	125
40 to 50	1.00%	27	40 to 50	3.62%	23
> 50	0.07%	2	> 50	0.47%	3
Total		2,710	Total		636

Conditioned vs. Unconditioned Space

An appliance that operates in unconditioned space tends to use more energy during warm/hot periods and less energy during cooler periods. Thus, understanding the appliance's location has implications on energy and demand savings. The Evaluation Team assumed that primary appliances operate in a conditioned space. Secondary appliances have the potential to operate in unconditioned space. However, the PY7 database did not capture the location of the appliance when it was operating. Therefore, the Evaluation Team leveraged

¹⁹ 59% of recycled refrigerators and 66% of recycled freezers were 15 years or older.

²⁰ Adjusted age for 2 refrigerators and 3 freezers that were older than 50 years.

PY5 location data and applied these assumptions (62% of refrigerators and 76% of freezers operate in unconditioned areas) to PY7.

Step 4: Apply Ex-Post Per-Measure Savings Algorithms

The Evaluation Team calculated ex-post savings for recycled refrigerators and freezers using the UMP. The UMP provides protocols intended to improve consistency across energy-savings calculations for common program measures. The Evaluation Team chose to implement the UMP for the following reasons:

- Low-cost savings method to implement transparent EM&V practices
- Ability to easily compare savings results from similar programs across different jurisdictions
- Includes various methods to estimate energy savings based on data limitations
- Provides algorithms and default variables that are otherwise unknown

Refrigerator Savings Methodology

Energy savings for this program is defined as the amount of energy consumption removed from the grid. Per the UMP, the Evaluation Team used a multivariate regression model to calculate an average unit energy consumption, adjusted it for partial use to determine average unit savings and applied the average unit savings to the ex-post quantity. Equation 7 shows the algorithm for calculating the energy savings for recycled refrigerators.

Equation 7. Energy Savings Algorithm for Recycled Refrigerators

$$Total\ KWH\ Savings_{Ref} = Average\ Per-Measure\ KWH\ Savings_{Ref} * Qty_{Ref}$$

$$Average\ Per-Measure\ KWH\ Savings_{Ref} = Average\ UEC_{Ref} * PUF_{Ref}$$

Where:

$$UEC_{Ref} = 365.25 * [Intercept + (C_{age} * Age) + (C_{Before1990} * F_{Before1990}) + (C_{size} * Size) + (C_{SingleDoor} * F_{SingleDoor}) + (C_{SidebySide} * F_{SidebySide}) + (C_{Primary} * F_{Primary}) + (C_{Uncond,CDD} * CDD * F_{Uncond}) + (C_{Uncond,HDD} * HDD * F_{Uncond})]$$

Where:

- Unit Energy Consumption (UEC) = energy consumption of refrigerators
- PUF = factor used to adjust for the amount of time refrigerators are plugged in annually; PUF for refrigerators is 0.94 based on PY5 evaluation results
- Intercept = intercept from regression model from UMP
- Coefficient (C) = The coefficient from regression model for each independent variable (see Table 92)
- Factor (F) = The factor from actual data in the database for each independent variable (see Table 92)
- Age = actual age (or adjusted age for refrigerators > 50 years old) of recycled refrigerator
- Size = actual size of the recycled refrigerator (in cubic feet)
- Cooling Degree Day (CDD) = average daily value of 6.27 using data from ASHRAE 2016 Fundamentals for Charleston and Columbia, South Carolina

- Heating Degree Day (HDD) = average daily value of 5.85 using data from ASHRAE 2016 Fundamentals for Charleston and Columbia, South Carolina

Table 92 provides the algorithm coefficients and factors used to calculate ex-post gross savings

Table 92. Refrigerator Unit Energy Consumption Regression Model Estimates and Average Program Value

Independent Variable	Coefficient (C _{variable})	Average Program Value (F _{variable})
Intercept	0.58	N/A
Age (years)	0.03	17.13
Manufactured Pre-1990	1.06	0.14
Size (cubic feet)	0.07	19.53
Single Door	-1.98	0.01
Side-by-Side	1.07	0.31
Primary Appliance	0.61	0.45
CDD	0.02	6.27
Unconditioned Space		0.62
HDD	-0.05	5.85
Unconditioned Space		0.62

Source: Uniform Methods Project: Chapter 7: Refrigerator Recycling Evaluation Protocol (September 2017); <https://www.nrel.gov/docs/fy17osti/68563.pdf>

The UMP does not include protocols for calculating demand savings. Thus, the Evaluation Team used the demand savings algorithm from the Illinois and Indiana Technical Reference Manuals (TRMs), shown in Equation 8.

Equation 8. Demand Savings Algorithm for Recycled Refrigerators

$$KW Savings_{Ref} = \frac{Average\ Per-Measure\ KWH\ Savings_{Ref}}{8,766} * CF$$

Where:

- Coincidence Factor (CF) = a number between 0 and 1 indicating how many refrigerators are expected to be in use during the peak summer demand period; the Evaluation Team applied a CF of 1 for refrigerators (Sources: Indiana and Illinois TRMs)

Freezer Savings Methodology

Freezer savings uses a similar method to refrigerators but uses different coefficient values. Equation 9 shows the UMP algorithm for calculating the energy savings for recycled freezers.

Equation 9. Energy Savings Algorithm for Recycled Freezers

$$Total\ KWH\ Savings_{Frzr} = Average\ Per-Measure\ KWH\ Savings_{Frzr} * Qty_{Frzr}$$

$$Average\ Per-Measure\ KWH\ Savings_{Frzr} = Average\ UEC_{Frzr} * PUF_{Frzr}$$

$$UEC_{Frzr} = 365.25 * [Intercept + (C_{age} * Age) + (C_{Before1990} * F_{Before1990}) + (C_{size} * Size) + (C_{chest} * F_{chest}) + (C_{Primary} * F_{Primary}) + (C_{Uncond,CDD} * CDD * F_{Uncond}) + (C_{Uncond,HDD} * HDD * F_{Uncond})]$$

Where:

- Unit Energy Consumption (UEC) = energy consumption of freezers
- PUF = factor used to adjust for the amount of time freezers are plugged in annually; PUF for freezers is 0.83 based on PY5 evaluation results
- Intercept = intercept from regression model from UMP (see Table 93)
- Coefficient (C) = The coefficient from regression model for each independent variable (see Table 93)
- Factor (F) = The factor from actual data in the database for each independent variable (see Table 93)
- Age = actual age (or adjusted age for freezer > 50 years old) of recycled freezer
- Size = actual size of the recycled freezer (in cubic feet)
- Cooling Degree Day (CDD) = average daily value of 6.27 using data from ASHRAE 2016 Fundamentals for Charleston and Columbia, South Carolina
- Heating Degree Day (HDD) = average daily value of 5.85 using data from ASHRAE 2016 Fundamentals for Charleston and Columbia, South Carolina

Table 93 provides the algorithm coefficients and factors used to calculate ex-post gross savings.

Table 93: Freezer Unit Energy Consumption Regression Model Estimates and Average Program Value

Independent Variable	Coefficient (C _{variable})	Average Program Value (F _{variable})
Intercept	-0.96	N/A
Age (years)	0.05	19.65
Manufactured Pre-1990	0.54	0.26
Size (cubic feet)	0.12	14.87
Chest Freezer	0.30	0.43
CDD	0.08	6.27
Unconditioned Space		0.76
HDD	-0.03	5.85
Unconditioned Space		0.76

Source: Uniform Methods Project: Chapter 7: Refrigerator Recycling Evaluation Protocol (September 2017); <https://www.nrel.gov/docs/fy17osti/68563.pdf>

The UMP does not include protocols for calculating demand savings. Thus, the Evaluation Team used the demand savings algorithm from the Illinois and Indiana Technical Reference Manuals (TRMs), shown in Equation 10.

Equation 10. Demand Savings Algorithm for Recycled Freezers

$$KW Savings_{Frzr} = \frac{Average\ Per-Measure\ KWH\ Savings_{Frzr}}{8,766} * CF$$

Where:

- Coincidence Factor (CF) = a number between 0 and 1 indicating how many freezers are expected to be in use during the peak summer demand period; the Evaluation Team applied a CF of 1 for freezers (Sources: Indiana and Illinois TRMs)

Step 5: Apply a PUF

Recycled appliances may not have operated in residential homes continuously. That is, some participants may store appliances unplugged. To account for this, the Evaluation Team estimated a PUF during the PY5 evaluation, based on the number of weeks that they stated those secondary appliances were in operation in the previous 12 months. This method is outlined in the UMP. The Evaluation Team applied a factor to assess the overall PUF for the previous 12 months (see Table 94). This analysis establishes the PUF by appliance at 0.94 for refrigerators and 0.83 for freezers. This means that the ex-post gross factors are reduced by 6% for refrigerators and 17% for freezers to account for the time period in which the recycled appliances were unplugged during the previous 12 months.

Table 94. Part Use Adjustment Factor by Appliance Type

# of Weeks Appliance Operated in Past 12 Months	Annual Percentage based on # of Weeks	Percentage Refrigerators (n=68)	Percentage Freezers (n=67)	Refrigerator PUF	Freezer PUF
All the time - primary	100%	51%	38%	0.51	0.38
All the time - secondary	100%	42%	41%	0.42	0.41
36 weeks	69%	0%	2%	0.00	0.01
26 weeks	50%	1%	2%	0.01	0.01
24 weeks	46%	1%	2%	0.01	0.01
20 weeks	38%	0%	3%	0.00	0.01
12 weeks	23%	1%	0%	0.00	0.00
10 weeks	19%	0%	3%	0.00	0.01
9 weeks	17%	0%	2%	0.00	0.00
Not at all	0%	3%	9%	0.00	0.00
Part Use Adjustment Factor				0.94	0.83

Note: Values rounded for reporting purposes; valid responses only.

Source: PY5 evaluation results

Step 6: Calculate Total Ex-Post Gross Energy and Demand Savings per Appliance Type

Ex-ante savings for refrigerators and freezers are based on the PY6 evaluation results. Following Steps 2–5 above, the Evaluation Team calculated fewer savings per measure, especially for freezers where ex-post energy and demand savings are 33% and 35% less than ex-ante estimates, respectively. The main factor driving this difference is the update to freezer savings methodologies in PY7. In PY6, the UMP did not provide protocols to calculate energy savings for recycled freezers. As a result, the Evaluation Team used the ENERGY STAR® Retirement Savings Calculator to estimate ex-post energy savings for freezers. However, a revised

version of the UMP was issued in 2017 that included protocols for calculating retired freezer savings. Consequently, the Evaluation Team applied the UMP protocols in PY7 to derive recycled freezer savings. The savings methodologies used to estimate refrigerator and freezer impacts are now consistent. Table 95 shows the ex-ante and ex-post per-measure savings.

Table 95. Appliance Recycling Ex-Ante and Ex-Post per Measure Savings

Measure	Ex-Ante	Ex-Post	Difference
KWH Savings			
Refrigerator	1,078	1,028	95%
Freezer	1,016	680	67%
KW Savings			
Refrigerator	0.12	0.12	98%
Freezer	0.12	0.08	65%

Table 96 shows the aggregate ex-post gross savings for the PY7 program.

Table 96. Ex-Post Gross Savings for Appliances

Measure Type	Ex-Post Quantity	Ex-Ante Gross Savings		Ex-Post Gross Savings		Gross Realization Rate	
		MWH	MW	MWH	MW	MWH	MW
Refrigerator	2,710	2,921	0.33	2,785	0.32	0.95	0.98
Freezer	636	647	0.08	432	0.05	0.67	0.65
Total	3,346	3,569	0.40	3,218	0.37	0.90	0.91

Note: Values are rounded for reporting purposes.

Step 7: Calculate and Apply NTGRs

The Evaluation Team applied the measure-specific NTGRs established in PY5 to the ex-post gross savings to estimate net savings for PY7.

Table 97. Appliance Recycling NTGRs

Measure Type	NTG Ratios	
	MWH	MW
Refrigerator	0.61	0.64
Freezer	0.71	0.74

Appendix F. EnergyWise for Your Business Detailed Methods

Desk Review Details

Prescriptive Lighting

The Evaluation Team performed desk reviews on a sample of 15 out of 628 Prescriptive Lighting projects. Table 98 details the 15 sampled projects and their individual realization rates, along with a short description of what caused the differences in verified and tracked savings. Table 98 lists projects in order of largest to smallest verified energy savings.

Table 98. Prescriptive Lighting Project Realization Rates

Project	Verified KWH	Verified KW	Energy RR	Demand RR	Reasons for Differences
1	314,310	39.72	100%	133%	Ex-post adds waste heat factors to interior lights. Ex-ante still applies a coincidence factor of 0.747 to all lights. Ex-post uses coincidence factor from CEAM based on building type and whether the lights are interior/exterior.
2	301,708	71.69	101%	117%	
3	238,065	62.07	99%	112%	
4	58,691	7.93	99%	40%	
5	386,574	51.33	100%	100%	
6	368,720	37.32	100%	100%	No discrepancies.
7	305,088	53.03	100%	100%	
8	116,237	12.63	100%	100%	
9	111,926	18.99	100%	100%	
10	63,158	15.89	100%	100%	
11	11,348	2.66	100%	100%	Ex-post determines "building type" at the individual measure level accounting for variation in lighting applications within projects. Ex-ante uses "building type" across all measures, occasionally applying incorrect waste heat factors or coincidence factors to measure applications; in particular, exterior lighting measures using interior parameters.
12	179,800	12.59	102%	26%	
13	111,346	23.98	100%	99%	
14	34,983	3.37	98%	33%	
15	20,651	1.55	111%	30%	

Prescriptive New Construction Lighting

The Evaluation Team performed desk reviews on a sample of 5 out of the 15 Prescriptive New Construction Lighting projects. Table 99 details the 5 sampled projects and their individual realization rates, along with a short description of what caused the differences in verified and tracked savings in order of largest to smallest verified energy savings.

Table 99. Prescriptive New Construction Lighting Project Realization Rates

Project	Verified KWH	Verified KW	Energy RR	Demand RR	Reasons for Differences
1	120,956	18.18	100%	173%	Ex-post adds waste heat factors to interior lights. Ex-ante still applies coincidence factor of 0.747 to all lights. Ex-post uses coincidence factor from CEAM based on building type and whether the lights are interior/exterior.
2	103,082	10.35	99%	117%	
3	23,240	5.32	99%	122%	
4	12,683	3.87	99%	122%	
5	51,952	10.74	100%	120%	Ex-ante still applies coincidence factor of 0.747 to all lights. Ex-post uses coincidence factor from CEAM based on building type and whether the lights are interior/exterior.

Prescriptive Non-Lighting

The Evaluation Team performed desk reviews on a sample of 10 out of 85 Prescriptive Non-Lighting projects. Table 100 details the 10 sampled projects and their individual project-type realization rates, along with a short description of what caused the differences in verified and tracked savings. Table 100 lists projects in order of largest to smallest verified energy savings.

Table 100. Prescriptive Non-Lighting Project Realization Rates

Project	Verified KWH	Verified KW	Energy RR	Demand RR	Reasons for Differences
1	81,385	30.61	51%	100%	Ex-ante uses SEER for energy savings. Ex-post uses EER in alignment with CEAM guidance for unitary systems equal to or greater than 65 kbtu/hr in size. Ex-ante uses different baseline values for EER and SEER. Ex-post uses values aligning with CEAM 2017.
2	55,870	6.90	90%	55%	
3	16,068	6.04	91%	100%	
4	12,393	3.09	72%	74%	
5	8,178	3.08	11%	100%	Ex-ante uses deemed values. Ex-post uses project-specific parameters to estimate savings.
6	46,446	5.58	226%	311%	
7	42,707	5.16	199%	275%	
8	8,716	1.73	42%	39%	No Discrepancy. Difference is due to rounding.
9	35,356	7.55	100%	101%	
10	28,408	3.24	100%	100%	No Discrepancy.

Custom

The Evaluation Team performed desk reviews on a sample of 10 out of 28 custom projects. The team treated lighting projects like the Prescriptive Lighting projects in that the team consistently applied coincidence factors and waste heat factors as applicable. Table 101 lists projects in order of largest to smallest verified energy savings.

Table 101. Custom Projects Realization Rates

#	Project Type	Verified KWH	Verified KW	Energy RR	Demand RR	Reasons for Differences
1	Lighting	2,233,732	271.16	99%	83%	Ex-ante does not apply coincidence factors or waste heat factors. Ex-post does
2	Lighting	39,113	4.47	125%	125%	
3	Lighting	27,212	6.91	99%	106%	

#	Project Type	Verified KWH	Verified KW	Energy RR	Demand RR	Reasons for Differences
4	Lighting	25,493	16.50	99%	80%	apply coincidence factors and waste heat factors.
5	Lighting	13,330	4.18	99%	91%	
6	Lighting	4,292	0.27	100%	28%	
7	Comprehensive Facility Improvement	568,088	123.00	100%	100%	No Discrepancy
8	HVAC System Improvement	236,747	123.20	100%	100%	
9	Building Envelope Improvement	67,058	N/A	100%	N/A	
10	Chiller	23,547	6.00	100%	100%	

*We cannot calculate realization rates when the ex-ante or ex-post savings are 0, and therefore denote these projects with 'n/a'.

Tracked and Verified Savings

The following charts provide a visual comparison between tracked and verified savings from the four samples. The line in the graph represents a 100% realization rate (or 100% correlation). Generally, the energy savings correlate well between tracked and verified savings as evidenced by the high realization rates previously discussed.

Figure 4. Tracked vs. Verified – Combined KWH

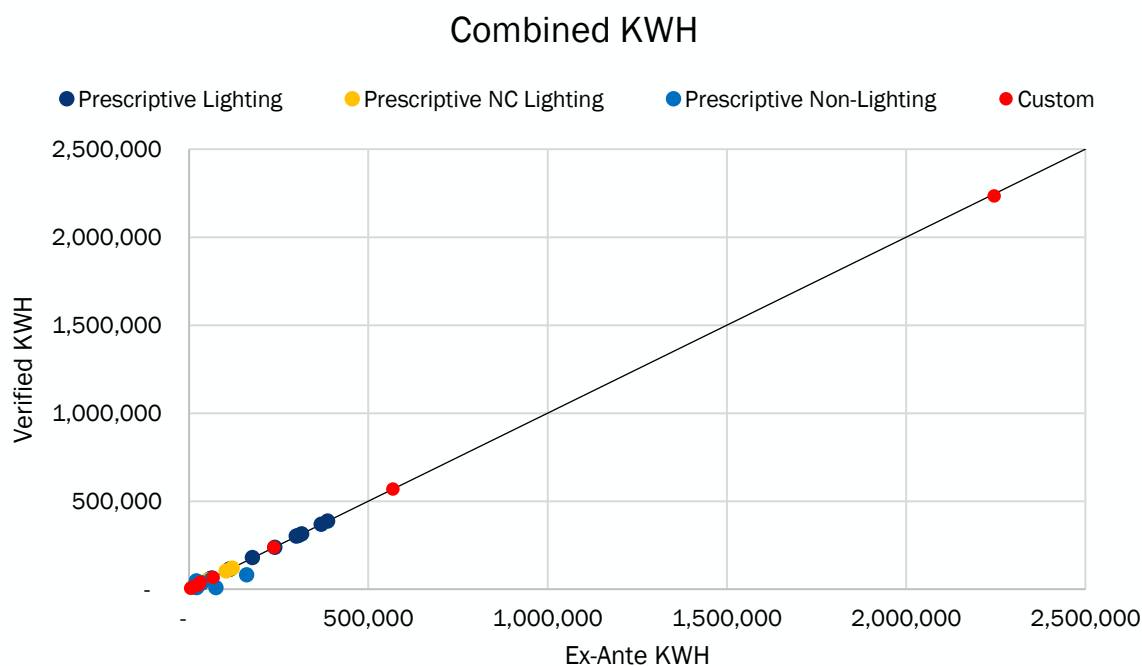
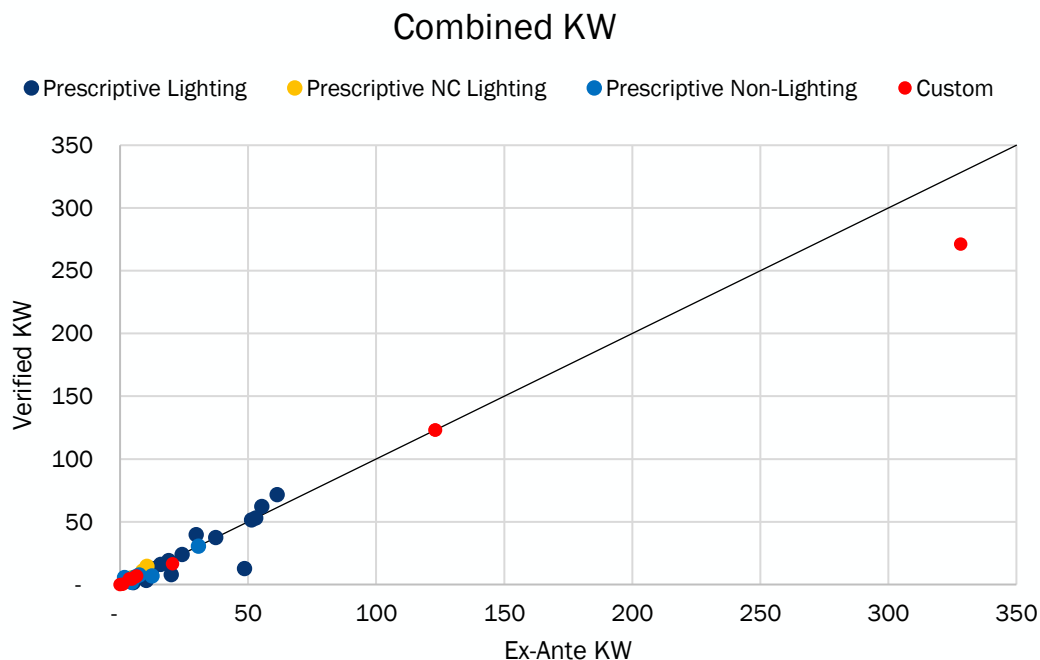


Figure 5. Tracked vs. Verified – Combined KW



Sample Design

The tables below provide the sample project stratum for the Prescriptive Lighting and Custom samples. The samples for Prescriptive New Construction Lighting and Prescriptive Non-Lighting were simple random samples and therefore do not have strata boundaries or any weighting of the sample. All samples were based off the September closeout file.

Table 102. Prescriptive Lighting Sample Stratum and Sampling Parameters

Stratum	Strata Boundary (KWH)	Population (N)*	Sample (n)	Sample Means (KWH)	Stratum Weight	Expansion Weight	Relative Weight
1	1-25,000	344	2	14,945	0.636	172.00	11.47
2	25,001-100,000	148	3	52,576	0.274	49.33	3.29
3	100,001-1,500,000	49	10	242,859	0.091	4.90	0.33
Total		541	15				

*Total number of projects does not match final reported total because sampling occurred on the September partial dataset.

Table 103. Custom Sample Stratum and Sampling Parameters

Stratum	Strata Boundary (KWH)	Population (N)*	Sample (n)	Sample Means (KWH)	Stratum Weight	Expansion Weight	Relative Weight
1	0-25,000	10	3	13,747	0.526	3.08	0.34
2	25,001-100,000	7	4	37,834	0.368	1.86	0.21
3	100,001-600,000	2	2	402,416	0.105	1.00	0.11
4	Certainty	1	1	2,245,501			
Total		20	10				

*Total number of projects does not match final reported total because sampling occurred on the September partial dataset.

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